THESIS TITLE

# THE EQUITY RISK PREMIUM PUZZLE REVISITED: THE CASE OF THE UK STOCK MARKET.

BY

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Thesis Abstract

The Equity Risk Premium Puzzle Revisited: The Case of the UK Stock Market

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This thesis stimulated and inspired by failings in the current literature investigates a series of issues relating to the UK Equity Risk Premium Puzzle. The UK market is focussed upon given prior research is heavily concentrated on the US market. The prior literature also focuses upon the aggregate equity premium. This thesis makes another important extension to prior work by analysing the equity premium for portfolios formed on cross-sectional characteristics such as size or industry. Specifically, it addresses the following three main issues. Firstly, is the historical equity premium an appropriate proxy for the expected equity premium? Secondly, does the use of the ex-post equity premium overstate the magnitude of the ex-ante equity premium puzzle? Thirdly, do low frequency equity returns follow different regimes over time?

The main results indicate that the alignment of ex-post equity returns with fundamental measures of equity returns depends upon both the time period considered and the measure of fundamental used. Empirical evidence also supports the view that the expected equity premium follows different regimes and thus does vary over time. This low-frequency time variation in expected returns appears to, in general, be systematic, affecting portfolios within the market at a similar time. Our results contribute to the academic literature and also have important implications for practitioners by offering insight into the nature of the Equity Premium Puzzle and the appropriateness of using ex-post returns as a proxy for ex-ante returns.

The material contained in this thesis has not been previously submitted for a degree in this or any other university.



Work largely based on this thesis entitled, "The UK Equity Premium: 1901-2004" by Andrew Vivian has been published in the Journal of Business Finance and Accounting Volume 34 Pages 1496-1527.

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# CHAPTER 1: THESIS INTRODUCTION

The Equity Risk Premium is of central significance within the field of financial economics. It is of key importance to fund managers for investment decisions, corporate executives for financing decisions as well as to many other economic agents. The Equity Risk Premium is simply defined as the return on the aggregate equity market minus the return on the risk-free rate. This central role played by the Equity Premium in no small part stems from the numerous applications that this single figure is used for within Finance.

For corporate financial managers the equity premium is a key determinant of the firms cost of equity and hence plays an important role in determining the overall cost of capital of the firm. The firm's overall cost of capital is used for instance when the company is attempting to decide which new investment projects to undertake and particularly is used to evaluate the present value of future cashflows. The equity premium will also play an important role for corporate managers in relation to financing decisions, since it's a key determinant of the cost of equity and this plays an important role in deciding the appropriate mix of debt and equity for the firm.

Investment analysts also rely upon the equity premium when making portfolio asset allocation decisions. Equities are typically one of the riskiest classes of assets and hence the equity premium, the return per unit of market risk is a crucial factor when analysts recommend what proportion of assets to be allocated to equities and what proportion to be allocated to other asset classes such as bonds, money, commodities or property. Investment analysts also use the equity premium for performance evaluation purposes of individual equities, portfolios or funds. For fund managers their performance relative to the benchmark is an absolutely vital, since it measures whether or not they have actually managed to create value for their investors relative to what could be expected.

Actuaries also require an accurate estimate of the equity premium for long-term financial planning purposes particularly in relation to personal pension funds. In recent decades the shift towards private provision of pensions from state provision means that individuals are more than ever today having to decide how much to save in order to adequately provide for themselves during retirement. Since, the long-term performance of equity markets has been extremely strong then increasingly pension funds tilt their asset allocation towards equities. Therefore, this places ever more significance on the equity premium estimates in the dual interrelated roles of projecting members pension payouts during retirement and determining members appropriate pension fund contributions.

Therefore the equity premium is of crucial importance and key significance for a plethora of diverse purposes and applications within the sphere of financial theory and policy. However, a question is how do we determine what the reward per unit of risk from investing in equities should be or what it can be expected to be? Similar to other financial phenomena research efforts within the current paradigm have attempted to explain the value of the Equity Premium through using rational models developed in economics. However, the Equity Risk Premium is just one example of a growing number of observable empirical results within financial economics which appear inconsistent with current financial theory. The current finance paradigm seeks to explain the behaviour of financial markets and the behaviour of agents participating in these markets by using rational models developed in economics. Over recent decades, though, areas and topics have emerged where rational economic models appear unable to fully explain the behaviour we observe in finance. Perhaps, this is no truer than in the case of equity premium puzzle. Standard economic models predict an Equity Risk Premium of less than 1% p.a., however long-term historical premia earnt by equities in the post-war period exceed 6% p.a. Thus, the huge difference between these estimates has generally been interpreted as a major failing of macroeconomic theory to provide an equity premia estimate in the vicinity of the historical equity premia. A vast literature has emerged that seeks to rationalise and attempts to explain these findings.

Since the seminal paper of Mehra and Prescott (1985) outlining the equity premium puzzle, an extensive literature has emerged attempting to shed light on the puzzle and ultimately to offer a plausible solution. Nevertheless, there has yet to emerge an explanation for the equity premium puzzle that appears to have gained widespread support. In this thesis we focus on one particular area upon which the analysis of Mehra and Prescott (1985) is based, namely are historical returns an appropriate proxy for expected returns. In order to investigate this assumption, we examine alternative measures of returns based upon economic fundamentals which we suggest are perhaps better indicators of expected returns than historical returns. Relatively few studies in our context have considered this issue of the appropriateness of historical returns as a measure of expected returns.

This assumption that historical equity premia are on average equal to expected equity premia is in fact only one of the assumptions made in the analysis of Mehra and Prescott (1985). Actually, most of the other assumptions made by Mehra and Prescott relate to the "standard" macroeconomic model they use. Therefore they make assumptions such as the economy consists of a single representative agent who maximises a power utility function and lives in a world where markets are both perfect and complete. The overwhelming majority of the equity premium puzzle literature that has emerged over the last two decades attempts to adapt and modify this standard macroeconomic model in order to provide an equity premium prediction closer to the historical average. Therefore models with heterogeneous agents or market imperfections or alternative utility preferences or incomplete markets have been formulated. However, none of these modifications have yet provided a prediction from the theoretical model that approaches the empirical reality.

We examine another possible explanation for this anomalous result that the empirical reality of an equity premium exceeding 6% p.a. could not have been expected by rational investors. Our primary area of focus for this thesis is the assumption that on average and in the long-run historical returns will equal expected returns has implications far beyond the equity premium puzzle. This assumption does not only underlie the analysis of the equity premium puzzle but is also made in the overwhelming majority of empirical studies in finance. Although, little mention of this assumption is usually made, it is necessary in order to conduct conventional asset pricing tests using historical data. Thus, the subject matter of this thesis and the implications of this thesis stretch far beyond its focus upon the equity premium puzzle. This thesis is of wider and much more general applicability to the field of finance since it examines a key assumption underpinning numerous empirical studies.

As mentioned the focus of this thesis is on examining the assumption made in the equity premium puzzle analysis of Mehra and Prescott (1985) that historical returns are on average equal to expected returns. The paper closest to the approach followed in this paper is that of Fama and French (2002). Fama and French (2002) argue that if dividends and prices are in a stable long-run relationship then dividend growth will provide an approximation of the price appreciation that could be expected. They suggest such an approach would also be applicable to variables other than dividends that were in a stable long term relationship with prices, such as earnings. Fama and French find that in the US since 1951 the historical average equity premium has far exceeded the equity premia implied by dividend growth and earnings growth. Hence they contend that since 1951, a substantial part of the historical average US equity premium was unexpected. In subsequent analysis, they find that recently ratios of dividend-price and earnings-price have hit historical lows and they interpret such a result as indicative that there has been a decline in the discount rate and hence a decline in the expected equity premium. A corollary of Fama and French's analysis is that since 1951 it appears that the historical average equity premium was a poor proxy for the equity premium investors' could have rationally anticipated.

However, thus far little research has emerged attempting to tackle the general issue of the appropriateness of the assumption that the historical average equity premium is an appropriate proxy for the equity premium investors' could have expected, let alone follow the approach of Fama and French (2002). The focus of this thesis is on the UK market, another of the world's major financial trading centres. Therefore whilst little is thus far known about the appropriateness of historical equity premium as a proxy for the expected equity premium in the UK context, some literature has emerged in relation to the UK equity premium puzzle. In Campbell's studies (1996, 2000, 2003) of the equity premium puzzle in international markets, he finds that the equity premium puzzle is very much in existence for the UK both over the MSCI period post-1970 but also in longer annual data series dating back to 1919. Dimson , Marsh and Staunton (2003) provide another international study of equity premia during the course of the 20$^{th}$ Century, however, they simply report historical returns rather than examining directly the equity premium puzzle. Hence, Dimson , Marsh and Staunton (2003) provide evidence that the UK was one of the best performing equity markets during the 20th Century, although the UK didn't quite match the searing performance of the US.

Hence this thesis seeks to fill some of the void left in the existing literature on the UK equity premium and lead to a substantial deepening of our understanding of this phenomenon. Furthermore, we attempt to extend the approach used in the prior literature and thus arguably the biggest contribution of the thesis is to extend previous analyses of the expected equity premium to industry portfolios and to size portfolios. Thus, in contrast to the extant literature we consider not just the expected aggregate equity premium but perform cross-sectional analyses. The key motivation in this is to attempt to identify if any divergences discovered between the aggregate market results are driven by a systematic factor. If discrepancies were caused by a systematic factor then such an effect should also be present in the time-series of portfolios formed on cross-sectional characteristics. Of course, the impact on the cross-sectional portfolios will depend on their exposure to the risk factor, but all portfolios should be affected nonetheless. Specifically, we consider how the collective performance of firms grouped according to industry membership or firm size differ from the market overall.

We address the equity risk premium in the UK, which appears to have been rather overlooked given the american centred nature of the current literature. Specifically, the first main objective of this thesis is to examine whether or not the *historical* UK equity risk premia of the magnitude observed is a suitable and fitting proxy for the *expected* UK equity risk premia could have been anticipated. Since expected returns are essentially unobservable, we shed light on this topic by examining the fundamental performance of stock market constituents. The rationale for this approach is that dividends are the only returns buy-and-hold investors receive from holding a stock and these dividends are in the long-run dependent upon firm's earnings. Hence, the expected capital gains of the company should reflect its expected fundamental performance. Overall, company fundamentals fluctuate much less than share prices and thus company fundamentals should provide more accurate estimates of expected capital gains than historical share price appreciation.

We therefore examine a number of key issues relating to this general topic. We attempt to shed light on this topic by considering a range of issues:

- To what extent have historical equity premia been supported by the underlying performance of fundamentals?
- Are there any discrepancies between historical returns and those implied by fundamentals?
- Do alternative measures of fundamentals yield results that are consistent with each other?
- Do the specific characteristics of the UK market lead to results that differ from other markets?
- Are the results for the aggregate market generalisable to portfolios formed according to cross-sectional characteristics?

If there are discrepancies between the historical equity premium estimates and those implied by fundamentals then we need to consider the factors which could have caused this to occur. For this issue our analysis is based on the insight of the present value model of stock returns. We especially draw upon the derivation of Campbell (1991) that demonstrates that deviations of actual returns from expectations can be attributed to either a change in expectations of future fundamental growth rates or a change in expectations of future expected returns. Hence this naturally leads us to ask the following auxiliary questions:

- Are deviations of historical returns from those implied by fundamentals due to a change in expectations of future fundamental growth?
- Is there time variation in expectations of future fundamental growth?
- Are deviations of historical returns from those implied by fundamentals due to a change in expectations of future returns?
- Have there been any structural changes in the relationship between prices and fundamentals?

Chapter 2 surveys the growing literature which has emerged in relation to the topics covered in the thesis. It begins with the establishment of the equity premium puzzle by Mehra and Prescott (1985) with their seminal paper. Then it proceeds to discuss the risk-free rate puzzle attributed to Weil (1989) but which is implicit in the formulation of the equity premium puzzle. Both these initial studies focus purely on US data for their empirical analysis, however, Campbell (1996, 2000, 2003) illustrates that these puzzles apply not only to the US but in almost all of the international markets he surveys. The assumptions under which these puzzles exist are stated and a review of the proposed modifications of these assumptions in an attempt to solve the puzzle. Therefore models with heterogeneous agents, differing and newly developed utility functions as well as incomplete and imperfect market scenarios are all examined and evaluated. However, even after such model modifications the puzzle still appears to remain in the sense that agents must be extremely risk averse in order for the proposed solution to match the empirical reality.

The literature review then examines the individual strands most pertinent to the topics covered in the thesis. Given that the current literature on the equity premium puzzle has largely focussed on attempting to modify the theoretical model to try and match the historical data, and research efforts have thus far failed to produce an adequate or acceptable solution then this leads one to question whether the historical equity premium could in deed have been expected. Therefore, we examine in considerable detail previous work that has examined and questioned the appropriateness of using historical returns as a proxy for expected returns. This part of the literature points to a sizeable gap where little work has yet been produced for markets outside of North America.

The literature review also includes a final section examining the size 'anomaly' given our focus on portfolios characterised by market capitalisation in Chapter 5. The size premium itself has proved in its own right to be something of a puzzle to financial economists since it is unclear why small firms should in fact earn higher returns than large corporations especially given that no firm foundation has been provided for the higher risk that small firms might expose investors to. Perhaps surprisingly we find in our review of the literature on the size premium that there has been virtually no evidence yet produced as to whether or not the historical size premium was expected by investors.

In Chapter 3 we examine the UK equity premium in the context of more than a century of UK data. This therefore makes an important contribution by examining the equity premium over an extremely long period, which is in fact longer than previous studies looking outside of the US have considered. We empirically examine if the historical equity premium is supported by growth in dividends. For the earlier part of the 20$^{th}$ Century it appears that historical average equity premia are commensurate with those implied by dividend growth. However, we find that this is not the case for the latter part of the $20^{th}$ Century and therefore examine what could have caused this discrepancy between equity premia estimates. It could be ascribed to either a change in expectations of returns or a change in expectations of dividend growth. Thus we provide further empirical analysis of both these issues. This chapter makes further contributions to the literature on both the predictability and forecastability of dividend growth. However, ultimately we find little evidence to support the hypothesis that a change in expected dividend growth caused the divergence in equity premia results. We do find evidence to maintain the hypothesis that there has been a change in expected returns. Our analysis on the structural stability of the dividend-price ratio reveals there was a permanent decline in the early 1990s. This is indicative that expected returns permanent fall in the early 1990s. Such a fall in expected returns can reconcile and explain our equity premia results for the post-1950 period.

In Chapter 4 we examine the equity premium across industry portfolios over recent decades. This is an important innovation since little attention thus far has been paid to the industry dynamic of the equity premium. As a matter of fact, the overwhelming majority of studies on the equity premium puzzle only consider the aggregate market. We contend that there have been widespread and dramatic changes in the nature of the industries comprising the market index over recent decades, which could potentially shed light on the nature of the puzzle. We provide evidence that this is in actuality the case. The results presented here question the extent to which historical returns deviated from that which could be justified on the basis of growth in fundamentals. In Chapter 4 we also consider earnings growth as an additional measure of fundamental growth alongside dividend growth utilised in Chapter 3. We find that the results of the expected equity premium model are dependent upon whether dividends or earnings are used as the measure of fundamentals. For most industries, when earnings growth is used as the measure of underlying performance then equity premium estimates are approximately the same as the historical average equity premium. In contrast when dividend growth is used we find that equity premium is in almost all cases smaller than the historical average, similar to the aggregate market results reported in Chapter 3.

In Chapter 5 we examine the equity premium across size and size-value sorted portfolios over 1966-2002. This chapter provides an investigation of the size premium, one of the most famous stock market anomalies. Of course the size premium can simply be viewed as just the equity premium on small firms minus the equity premium on large firms. Hence the size premium is closely related to the equity premium, the central theme of this thesis. We begin by revisiting the evidence on the scale of the ex-post size premium in the UK, providing evidence that questions the conventional wisdom which maintains the size premium either disappeared or reversed following its discovery. However, the major innovation of the chapter is to examine the degree to which the size premium is supported by underlying fundamentals. There is virtually no prior research, thus far, that examines whether or not this cross-sectional return could be expected – at least in terms of the differentials between fundamental growth rates of small and large firms. This chapter seeks to bridge this gap in the literature by specifically focusing upon this issue of whether a size premium is expected on the basis of differentials in growth rates between small and large companies. We find that in fact the size premium is supported by a differential in underlying fundamental growth between large and small firms and hence such a premium can be expected.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 EQUITY PREMIUM PUZZLE LITERATURE REVIEW

The current finance paradigm is based upon a couple of key basic fundamentals. The first is the existence of a linear relationship between risk and expected return for the asset pricing model considered. The second draws upon the economic framework that financial economics has evolved from. This assumed economic environment is based upon the belief that almost all behaviour can be explained by assuming that rational agents with stable well-defined utility functions interact in well-functioning markets. In such a framework, an empirical result qualifies as an anomaly if it is hard to explain using standard models or if implausible assumptions are necessary to solve it within the paradigm. One such example of an empirical result which is believed to be an anomaly is the equity risk premium.

The equity risk premium is the reward, in terms of the difference between the return on the equity market portfolio and a risk-free asset, for exposing oneself to the risk of the market portfolio. The theoretical price of bearing this risk can be derived from the consumption capital asset pricing model (CCAPM). The CCAPM assumes investors use financial securities to transfer consumption opportunities from periods when they are plentiful to periods when they are scarce. In equilibrium, this model asserts that the current utility foregone by investing is exactly equal to the expected utility gain from future consumption when the asset pays off.

$$p_t u'(C_t) = E_t[\beta u'(C_{t+1}) x_{t+1}]$$

The current utility forgone is given by the price of the asset or amount invested ($p_t$) multiplied by the marginal utility of current consumption [$u'(c_t)$]. $\beta$ determines how much future consumption is less desirable than current consumption, $u'(c_{t+1})$ is the marginal consumption of future consumption at time t+1 and $x_{t+1}$ is the future payoff received at time t+1. Therefore the product of these 3 terms gives us the expected utility gain from consumption in the next period from investing $p_t$.

Mehra and Prescott (1985) took a rather circuitous route to analyse the equity premium. Their approach employs a general equilibrium model, based upon Lucas' (1978) pure exchange economy. In such an economy, the joint process governing the growth rates in per capita consumption and asset prices are stationary and clearly defined. The economy has a single representative agent, who decides upon his optimal consumption plan according to its utility function. It's assumed that the agent has a constant relative risk aversion (CRRA) utility function. Thus the current value of expected future utility is expressed as: $E_t \sum_{1}^{\infty} \frac{B^s (C_{t+s})^{1-a}}{(1-a)}$, where a>0, where $E_t$ is the expectation at time t, $B$, is the discount factor of future consumption, $C_t$, is the random consumption stream, and $a$, is the coefficient of risk aversion[1].

Mehra and Prescott (1985) demonstrate that within standard models of the CCAPM and by making only plausible assumptions that the reward for investing in stocks is far greater than can be justified by the degree of risk taken. They assume there is a representative agent, who has an additively separable utility function, and constant relative risk aversion.

[1] $a$ the coefficient (of relative risk aversion), which is the percentage that the marginal value of a dollar income must increase to offset a 1% fall in consumption, for equilibrium to hold.

They used data from 1889-1978 for their study. The start date was the earliest for which reliable consumption and growth data available. For this sample period, the average real rate of return on bonds is 1% but is 7% for stocks, yielding an equity premium of 6% per annum. Actually, Mehra and Prescott found the maximum admissible value for the equity premium to be 0.35%, obviously this is completely inconsistent with the observed historical rate of 6%. In this model, *a* would need to be approximately 30-40 to explain the historic equity risk premium. Many empirical studies have estimated the coefficient of risk aversion since it's of importance in many fields of economics and the general consensus is that its value should be around 1-2[2]. Hence, *a* of 30 or 40 is believed to be an implausibly high level of risk aversion, it implies individuals desperately want to smooth consumption over time.

Hansen and Jagannathan (1991) developed volatility bounds as a diagnostic for asset pricing models. This places a limit on the maximum (or minimum) possible mean of an asset for a given asset's variance. If an asset is placed outside of the volatility bounds then it can be deemed inconsistent with the data or anomalous. When evaluating the return on equities using the Consumption CAPM then the Equity Premium is plotted staggeringly far outside of the volatility bound. This method is a very direct way to assess if a given data set is consistent with the model under consideration and consequently it has been used extensively to assess the equity premium.

Weil (1989) extends the analysis to look at the risk-free rate and concludes that actual bond returns are puzzlingly low compared to the prediction of the model. This points to a second puzzle, the low risk-free rate. This leads Epstein and Zin

[2] Arrow (1971), Friend and Blume (1975)

(1991) to comment that "existing results suggest that explaining bond and stock returns jointly poses a problem for the expected utility model."

Campbell (1996, 1999, 2003) documents that the equity premium and risk-free rate puzzles are not merely confined to the US market. Using the Hansen-Jagannathan (1991) bounds method, Campbell shows that these puzzles are also prevalent in all 10 international security markets he considers throughout the world based on data from 1970 onwards. They are also apparent in longer datasets for the UK and Sweden dating from 1920 onwards. Campbell also provides evidence that these puzzles are robust to the use of long-term bonds in place of treasury bills as the relatively safe asset. Thus, he also finds that a bond premium and equity-bond premium puzzle exist in all 10 international stock markets.

### 2.2.1 DEFINITION OF THE EQUITY PREMIUM PUZZLE:

The equity premium puzzle has spawned a huge literature that attempts to provide a solution to the puzzle. Much of this research has questioned the underlying assumptions of the model and the rational economic paradigm. The analysis of the Equity Premium Puzzle by Mehra and Prescott, and Campbell rests upon are the following assumptions:

i) Asset markets are complete.

ii) Financial markets are perfect.

iii) Investor preferences can be well described by a power utility function.

iv) There is one homogeneous agent who invests in the stock market.

v) Realised returns are on average equal to investors' expected return.

vi) Consumption is the agent's ultimate aim (or if wealth is investor's ultimate aim then consumption is a suitable proxy for it).

vii) Economic agents can't rationally be so risk-averse as to have a coefficient of relative risk aversion ($a$) of 10, let alone 20 or 40.

Any solution to the equity premium puzzle must relax at least one of these assumptions, each of which tends to be very commonly made within the financial economics paradigm. In fact, in the literature that has emerged on the equity premium puzzle each of these assumptions have been challenged by researchers. Some assumptions have been examined particularly extensively, whilst others have received relatively little attention. We examine the literature relating to each assumption in turn in the following sections.

### 2.2.2 MODIFICATIONS TO THE UTILITY FUNCTION

The analysis of Mehra and Prescott (1985) makes the assumption that investor preferences can be well described by power utility functions. Although, such Constant Relative Risk Aversion Utility functions are used widely in economics there have been at least a couple of major flaws documented relating to them. Whilst these critiques are general criticisms of these type of utility functions, they are of course of pertinent to all applications where they are employed. Thus, these critiques have important implications for many separate and disparate areas of economics of which the Equity Premium Puzzle is just one topic. They have been seen as of particular relevance in the Equity Premium Puzzle literature given the formulation of the puzzle by Mehra and Prescott (1985) is based upon the assumption that the representative agent has a utility function with constant relative risk aversion. The two major failings of the Constant Relative Risk Aversion Class of Utility functions are expounded below:

Firstly, Constant Relative Risk Aversion restricts the elasticity of intertemporal substitution to be the inverse of risk aversion. Since the equity premium puzzle requires investors to be implausibly highly risk averse; it also implies that investors are also incredibly reluctant to transfer consumption from one period to another. i.e. the inter-temporal elasticity of substitution is implausibly small. There is some debate in the literature as to what the appropriate value for the elasticity of intertemporal substitution is. For instance, a recent study by Yogo (2003) suggests the US elasticity of intertemporal substitution is approximately 0.2. Vissing-Jorgenson and Attansio (2003) contend that when one looks at only households which are stockholders then the intertemporal elasticity rises to 1 or more. Nevertheless, models that restrict the value of the elasticity of intertemporal substitution to equal the coefficient of relative risk aversion tends to be strongly rejected by the data.

Secondly, Rabin (2000) and Rabin and Thaler (2001) passionately argue and provide illustrations that investors do not behave as if they face constant risk aversion. They demonstrate that if an investor rejects a gamble when a small loss is involved then if he behaves consistently with that level of risk aversion he will reject gambles when larger losses are possible even when huge possible gains are probable (that no sane individual would reject). Thus, they convincingly suggest that individuals do not exhibit the same degree of risk aversion for large gambles as they do for small gambles!

### 2.2.3 RATIONAL ECONOMIC MODIFICATIONS TO THE UTILITY FUNCTION

The first group of theoretical explanations to the equity premium puzzle modify the utility function of the representative agent. One approach used by Epstein and Zin (1989 and 1991) was to use a generalised expected utility (GEU) function. This utility function can be expressed as:

$[(1\text{-}B)\ C^{p}_{t} + B(E_t(U^{a}_{t+s})^{p\text{-}a}]^{(1/p)}$. This is where the elasticity of substitution equals 1/(1-p). Thus utility is a constant elasticity function of current consumption and future utility. This breaks the link between relative risk aversion and the elasticity of intertemporal substitution, which is important because the relationship assumed by the original utility function does not seem to hold. It also means that this utility function doesn't view economic growth as disutility, which Mehra and Prescott's does. Hall (1988) corroborates the findings of Epstein and Zin (1991) that the elasticity of substitution is small. The GEU approach is capable of explaining approximately one third of the premium and it is able to explain the low risk-free rate puzzle by allowing intertemporal substitution and risk aversion to be high simultaneously.

More recently Melino and Yang (2003) adapt recursive utility functions to include state-dependence. Their model allows for (counter-) cyclical variation in risk aversion and cyclical variation in intertemporal substitution. Their results suggest that cyclical variation in risk aversion alone adds little prospect of resolving the puzzle. However, in a setting with strong counter-cyclical variation in risk aversion and modest cyclical variation in intertemporal substitution the first two moments of the returns on equity and the risk-free rate can be matched. Nevertheless it still appears as if investors' are required to be extremely risk-averse in recessions for the model to appropriately fit the data.

Another utility function that can lower the intertemporal elasticity of substitution is habit formation. This is the concept that the utility of future consumption is sensitive to our current consumption. For example, if an individual that has high consumption today will become accustomed to high consumption and will have a greater longing for consumption in the next time period. This is expressed by the utility function: $E_t \sum_{1}^{\infty} \frac{B^s (C_{t+s} - C_{t+s-1})^{1-a}}{(1-a)}$. As consumption today increases, utility tomorrow decreases. Thus, it will take more consumption tomorrow, to yield a given level of utility, if he consumes more today, than he is accustomed to.

Constantinides (1990) and Heaton (1995) claim that habit formation could be the key to explaining the difference in returns between stocks and bonds. This is because habit-forming functions allow for a high variability of the marginal intertemporal elasticity of substitution with low variability of consumption. However while this is the case, the representative agent is indifferent between stocks and bonds, only if he is highly averse to consumption risk. Thus, habit formation, by itself is unable to resolve the equity premium puzzle.

However, Chapman (2002) demonstrates that the encouraging performance of the Constantinides (1990) intrinsic habit model in respect to the resolution of the equity premium puzzle is due to pre-1948 consumption data. Since 1949, consumption growth has been much less volatile and thus the intrinsic habit model is unable to reconcile asset returns with consumption growth mean and standard deviation for reasonable values of the curvature parameter.

Abel (1990) asserts that our utility is sensitive to the consumption of our peers, which he refers to as keeping up with the Joneses'. In this model the utility function is defined as: $E_t \sum_{1}^{\infty} \frac{B^s (C_{t+s}/X_{t+s})^{1-a}}{(1-a)}$ Here, the parameter $X_t$ is the habit level, determined by average social utility, or the influence of past consumption on today's utility. Thus if society in general has high consumption, then we will require much higher consumption to yield a set level of utility than if our peers' consumption is low. He finds that an $a$ of 6 can provide a reasonable estimate of bond returns and the equity premium. Nevertheless, even an $a$ of 6 could be thought of as being excessively high. The model also gives levels of volatility, particularly of the risk-free rate that are too large relative to the levels observed in reality.

Campbell and Cochrane (1999) extend the model of habit formation introduced by Abel (1990). However, they capture the relationship between consumption and habit by making use of the surplus consumption ratio ($S_t$). This is defined as: $S_t = \frac{C_t - X_t}{C_t}$, which is simply the excess of current consumption over the habit level divided by current consumption. They demonstrate that if the habit level is fixed then if consumption rises then risk aversion falls. Thus, during economic expansions investors are less fearful of consumption shocks than during periods of recession. They represent the log consumption growth process as a random walk with an iid error term: $\Delta C_{t+1} = g + \varepsilon_{c,t+1}$. The evolution of the habit is governed by the log surplus consumption ratio and evolves over time according to an AR(1) process: $s_{t+1} = (1-\varphi)\bar{s} + \varphi s_t + \lambda(s_t)\varepsilon_{c,t+1}$ $\varphi$ is the persistence parameter of the log consumption ratio, while $\lambda(s_t)$ determines the sensitivity of habit and so surplus consumption to innovations in consumption growth. This is a complex non-linear function of current and past consumption. A linear approximation can be given by:

$x_{t+1} \approx (1-\varphi)\alpha + \varphi x_t + (1-\varphi)c_t = \alpha + (1-\varphi)\sum_{j=0}^{\infty}\varphi^j c_{t-j}$. However, linearising the model in such a manner has a potentially serious defect. This model may well lead to a highly volatile risk-free rate. However, when consumption falls below the habit level utility cannot be determined, which could quite possibly occur given the exogenous consumption process assumed by Campbell and Cochrane. Campbell and Cochrane therefore restrict the model so that the risk-free rate is constant.

There are a couple of flaws with the Campbell-Cochrane model, which lead to it being unable to offer a full rationalization of the equity premium puzzle. Firstly, Guvenen (2003) notes that the Campbell-Cochrane model restricts the risk-free rate so it is constant, i.e. $\sigma(R_f) = 0$, however, this is at odds with the US historical volatility of 5.44%. Secondly, although their utility function has time-varying risk aversion, in order for it to rationalise the equity premium puzzle risk aversion would still need to be greater than 50 during "bad" economic states; thus this still requires an excessively high coefficient of risk aversion in order to explain the puzzle.

Chang (1990) demonstrates that using time-varying risk aversion provides a solution to the puzzle. He used multiplicative separable preferences instead of the time-additive preferences used by Mehra and Prescott (1985). Chang (1990) found this to explain the equity premium puzzle with reasonable values of risk and time preference parameters. The use of time varying relative risk aversion appears to be an important ingredient to explain the puzzle. However, this approach is unconventional since it is generally assumed that risk aversion is constant over time. Further, for short time periods, it is very difficult to estimate risk aversion accurately or precisely. Thus, it does not offer convincing evidence that the equity premium puzzle can be resolved in this manner. Finally, whether or not economic agents truly behave in a manner consistent with multiplicative utility functions is a disputed issue; it has yet to be adequately established that agents do behave in such a fashion. Melino and Yang (2003) demonstrate if utility is addiditive rather than multiplicative then time-varying risk aversion alone offers little improvement over the power utility model.

Bakshi and Naka (1997) conduct an empirical investigation of the performance of models using various different preferences for the Japanese market. They consider time non-separable utility, external habit formation utility (Abel, 1990) and recursive utility (Epstein-Zin, 1991). Their tests suggest that the habit formation utility function of Abel (1990) is the best performer. They further find that the recursive utility preference structure is rejected by their data.

### 2.2.4 BEHAVIOURAL FINANCE APPROACH

Another approach has looked at departing from the consumption-based model. Instead of attempting to adapt the utility function to explain consumption, another approach is to consider changes in financial wealth. Financial wealth fluctuations are deemed to be of direct concern to the investor and thus should be incorporated into agents' preferences. This can be seen as an extension of the traditional asset-pricing framework. [Barberis, Huang and Santos, 2001]. However, such studies not only depart from the established consumption-based model but also tend to depart from the established style of utility functions commonplace in economic studies.

Kahneman and Tversky (1979) question the validity of traditional utility functions. They argue that the value function differs from that assumed by conventional economic models in a serious manner. They claim the function of wealth (or payout) is kinked at a reference point. Below the reference point the function has a steeper slope than above. If the reference point is 0, this indicates that reductions in financial wealth cause a proportionately larger sense of dissatisfaction than the pleasure generated from an increase in financial wealth. In other words, investors are more averse to losses than to gains. Tversky and Kahneman (1991) estimate empirically the degree of loss aversion. Their results indicate that the disutility of giving something up is twice as great as the utility from gaining it. From this research you can derive the utility function: $U(x) = x, x>0; U(x) = 2x, x<0$. This demonstrates that financial losses hurt agents more than gains yield pleasure relative to a reference point.

Benartzi and Thaler (1995) make the contribution of utilizing this concept of loss aversion, developed from psychological investigations and applying it to the equity premium puzzle. This is based on the idea that agents are concerned with financial wealth fluctuations, thus to analyse the performance of loss aversion we need to determine the investment horizon of our agent. What is the time-frame our representative agent uses to evaluate the performance of his investments and derive utility from them? If the investment horizon is 20 years then we make the supposition that stocks will, on average, be much more attractive than bonds; equities will tend to earn far higher returns over this period than bonds and thus yield far superior levels of utility. However, if our agent evaluates utility every day, investing in stocks is very unattractive because they fall almost as much as they rise. Thus, for loss aversion to explain the premium puzzle, the investor would need to be indifferent between stocks and bonds i.e. they would need to yield the same level of utility.

Benartzi and Thaler's approach is to find the evaluation period that makes investors indifferent between stocks and bonds. They generated distributions of returns for various time-horizons from CRSP time-series data. They used this to calculate the prospective utility of the given assets. This approach identifies that an evaluation period of just over one year leads to the equalization of prospect utility between stocks and bonds when nominal returns are used, while real returns require an evaluation period of 11 months. Thus it can provide a solution to the puzzle. Fielding and Stracca (2003) also examine loss aversion and make the contribution of identifying the level of risk aversion necessary for investors to be indifferent between stocks and bonds. Consistent with the findings of Benartzi and Thaler (1995), they report that loss aversion can only explain the puzzle for very short time horizons, such as one year. If agents have longer investment horizons then this explanation would rely upon individuals being implausibly risk averse.

A second form of the Kahneman-Tversky value function, disappointment aversion, has been developed by Gul (1991). In this model utility is not evaluated according to negative or positive fluctuations in financial wealth, but rather realized returns are evaluated against expected returns. The difference between the theories is that the reference point is no longer zero but is now equal to the level of expected returns. Thus returns in excess of expected returns are deemed surprises while lower than expected returns are called disappointments. Disappointments are more painful to agents than surprises are beneficial. Thus the logic underlying the utility function is identical to loss aversion. Fielding and Stracca (2003) also evaluate the ability of disappointment aversion to explain the US equity premium puzzle. They report that disappointment aversion can resolve the equity premium puzzle over both short and longer time horizons. Even over 10 year horizons the utility derived from bonds and equities can be equated with plausible levels of risk aversion.

Benartzi and Thaler (1995) asserted that an evaluation period of approximately one year is reasonable given the tendency of mutual funds to report to their investors on annual basis. Thus, the loss aversion solution to the premium puzzle is to "combine a high sensitivity to losses with a prudent tendency to frequently monitor one's wealth." However, if investors are actually averse to disappointments rather than losses, then even if individuals have longer time horizons the puzzle can be explained; disappointment aversion only requires agents to be more sensitive to returns that fall below expectations than to returns that exceed expectations.

However these behavioural finance approaches do have drawbacks. Firstly, they examined preferences over returns *per se* not over consumption. There is a strong preference amongst financial economists for a unified approach that can link asset returns to the macro-economy (Campbell (2000), Cochrane (2007)). An integrated model (such as the CCAPM) has the benefit of allowing us deeper insights into the interaction between financial markets and agents' consumption, investment and savings decisions. Furthermore, academics and practitioners are yet to be convinced that preferences derived from psychological studies are more useful or more realistic than traditional utility functions. For example, Campbell (2000) refers to the "modeling of nonstandard investor behaviour" (p1552) to describe utility functions developed through 'behavioural finance.' Many are still to be convinced of the need to have different functions for gains and losses. A further practical problem with implementing this approach is ascertaining what the representative agent's time horizon is. This is very difficult to assess this with any degree of certainty.

Shrikhande (1997) proposes a model of non-addictive habit formation which is formulated in a continuous time framework, which also incorporates the notion that investors dislike disappointments more than they enjoy surprises. This complements the work of Constantinides (1990) who models addictive habit formation. However, it builds on the notion of Duesenberry (1967) that the degree of deprivation from a decline in the consumption rate is much stronger than the sense of euphoria from a corresponding increase in the consumption rate. Thus, the utility function incorporates a penalty based approach when consumption falls below the past habit-forming consumption rate. "in my model all the weight is placed on the most recent habit-forming consumption rate." (p295)

The function employed is consistent with the Kahneman-Tversky value function, and as mentioned above, incorporates the behavioural notion that gains yield less pleasure than the sadness induced by a corresponding fall in consumption. The reference point is this case is the past habit-forming consumption rate. Thus, these preferences do reflect the findings of experimental tests on investor behaviour. Shrikhande's model relies upon constant relative risk aversion

Non-addictive habit formation complements and extends prior research. For example, unlike Constantinides (1990) the real riskless interest rate is endogenised. Furthermore, for a fall in consumption below the habit level there is a finite rather than an infinite penalty as in the models of Constantinides (1990) and Sundaresen (1989). Habit formation provides a strong justification for a consumption series that is smoother than the wealth series.

Non-addictive habit formation does provide a resolution to the equity premium puzzle. The parameter values required to resolve the puzzle appear to be reasonable.

### 2.2.5 INDIVIDUALS REALLY ARE EXTREMELY RISK AVERSE

Mehra and Prescott's formulation of the equity premium puzzle permitted a maximum coefficient of relative risk aversion of 10, which appeared a somewhat high upper bound given the extant microeconomic literature. Since Mehra and Prescott find a coefficient of risk aversion much greater than 10 is required to generate a risk premium of the magnitude observed historically in the US they state the equity premium is puzzling.

> Kocherlakota (1996) argues if utility functions are to explain the equity premium puzzle within the current paradigm, "Individuals must either be highly averse to their own consumption risk or to per

capita consumption risk if they are to be marginally indifferent between investing in stocks or bonds."

Nevertheless, some economists contend that agents in certain circumstances actually are extremely risk-averse. Kandel and Stambaugh (1991) subscribe to the view that individuals are highly averse to their own consumption risk. They claim the equity risk premium isn't a puzzle because individuals can really be *extremely* risk averse for very small shocks to investor wealth. They believe $a$ equal to 29, which is the necessary figure their analysis requires to solve the puzzles, is possible. They illustrate with the example of an investor facing a gamble with a 50% chance of winning but also a 50% chance of losing. In this case the gamble is for 0.5% of the investors' wealth, \$375, then the investor would be willing to pay \$1.88 to avoid the gamble if alpha equals 2, whereas if alpha is 30 he would pay \$28. It would appear that the second result appears more plausible and investors could be highly risk averse. However, they also demonstrate that for a similar gamble for 1/3 of the investors' wealth, then if alpha is 30 the investor would pay \$24,000 to avoid losing \$25,000 whereas if alpha is 2 then he will pay \$8,333. Clearly, alpha equal to 2 appears more sensible in this case with alpha equal to 30 yielding an absurd result. These illustrations demonstrate that risk aversion can be sensitive to the size of gamble considered. Thus, they believe one should not automatically disregard such high values of relative risk aversion as 29. Hence they find that "the key ingredient in obtaining a high equity premium is a high aversion to small gambles."

Rabin (2000) shows that standard expected utility theory has serious failings if an individual turns down a gamble where s/he might lose only a small amount. If an individual for example turns down a 50-50 gamble of winning £11 but losing £10, then they would always reject a 50-50 bet of losing £100, no matter what the potential gain were. Even if it were £2.5 Billion! Thus, there appears to be some seriously disturbing and seemingly implausible implications of risk aversion in the expected utility framework.

Consequently Rabin's study suggests that assuming that risk aversion is fixed for small and large gambles is incompatible with what we would believe to be 'normal' or 'rational' human behaviour! Reasonable behaviour over small gambles implies unreasonable behaviour when large gambles are considered. However, for the equity premium puzzle we have seemingly unreasonable behaviour when substantial funds are invested, which would suggest if we apply the same risk aversion coefficient to small gambles we would have doubly unreasonable outcomes.

Nevertheless, until we are aware of the proportion of individuals' wealth invested in securities it will fall short of offering an acceptable solution to the equity premium puzzle. Is the proportion of wealth invested in equities low enough to justify high $a$ values? If not, then it can't help explain the equity premium puzzle. Our representative agent, one would surmise is not concerned with investing tiny sums of money but rather economically substantial amounts. The saving decision is one of the key economic decisions agents make and the equity market is a large and increasingly important vehicle for saving. Thus, this anecdotal evidence would suggest that the analysis of Rabin (2000, 2001) does not appear to considerably aid the search for a solution to the Equity Premium Puzzle.

Furthermore, even if some empirical support for the hypothesis were to emerge, it is likely that a great deal of further evidence to verify this solution would be necessary because generally very high levels of risk aversion are not commonly accepted. For example, Lucas (1994) claims that any proposed solution that, "does not explain the premium (with) Alpha < 2.5 ... is ... likely to be viewed as a resolution that depends on a high degree of risk aversion."

Papers which claim to provide solutions to the equity premium puzzle, but require relative risk aversion to be 10 or 20 or 40, are likely to be simply viewed as insufficient to persuade the majority of economists that an adequate solution to the equity premium puzzle has been provided. For risk aversion to be 30 or larger then investors would have to be terrified of the potential downside potential of their portfolio. In fact it has been suggested that if one accepts a level of risk aversion of 30 or more as a solution to the equity premium puzzle then this should be deemed the "smelly" solution. This is because if someone truly was that risk-averse then they would never take a bath as they would be far too worried about the risk of slipping and falling over getting into the bath. Mehra and Prescott (1985), thus conclude the premium is far too big, in fact puzzlingly massive and is unable to be explained by a standard consumption-based model.

### 2.2.6 MARKET IMPERFECTIONS

Another explanation could be that transaction costs might remove the apparent utility benefits of trading stocks. This relaxes the seemingly unrealistic assumption made under perfect markets that trading is costless. Aiyagari and Gertler (1991) refer to the 3 main transaction costs involved in dealing shares as: a) brokerage commission costs, b) bid-ask spreads and c) information costs. For individual investors the largest fees appear to be the brokerage fees which when Aiyagari and Gertler (1991) wrote tended to be about five to eight per cent of the total value of the transaction. The bid-ask spread costs are smaller and were about 0.5% for the largest 50% of firms but they increase as firm size decreases to average 1% for the smaller 50%. However, for the very smallest firms the spread can be more than 5%. These are the main financial costs involved in trading, but managing a stock portfolio is neither costless nor effortless in terms of the information costs involved. However, transaction costs can only be a way to explain the equity premium if one can assert that there are significant differences in trading costs across the stock and bond markets. Can transaction costs for stocks really be that much higher than for bonds? They would appear to be higher. Equities are more frequently traded and brokerage, spread and information costs for bonds would be smaller than for stocks. Further, Bogle (1999) finds that the cost of holding a mutual index fund is approximately 1-2% of total investment per annum, which is a substantial expense. Taking account of this would reduce equity returns and the equity premium by the same amount, going some way to explain the puzzle. However, transaction costs have not yet been incorporated into models of the CCAPM. Thus it is difficult to examine the extent to which, they can help explain the equity premium, unless we make seemingly arbitrary adjustments to returns, which we would prefer to avoid. At best, transaction costs can provide a partial explanation for the magnitude of the premium; it is difficult to see how they can offer a full solution to the puzzle.

The He and Modest (1995) trading costs model has the impact of lowering returns. Consequently, the imposition of market frictions reduces the incentive for consumers' to invest in assets and thus substitute future consumption for current consumption. He and Modest provide specifications of the fundament valuation relationship when there are market imperfections. They identify the case of short-sale constraints, borrowing constraints and transaction costs. Estimations of the Hansen-Jagannathan volatility bound are performed for each type of market friction and for many combinations. It appears that market frictions are capable of stretching the mean-variance volatility bound outwards for assets that are negatively correlated with consumption, but has only a marginal impact upon the bound for assets that are positively correlated with consumption. Stock returns are positively correlated with consumption and thus consequently this model of market frictions looks doomed to fail in explaining the equity premium puzzle.

Luttmer (1999) uses a different approach which focuses upon fixed trading costs, whereas much of the costs in He and Modest (1995) varied with the size of transaction. Luttmer (1999) estimates that a minimum fixed cost of 5.75% of monthly consumption would be required to rationalise the equity premium, if the other assumptions in the traditional formulation of the equity premium puzzle are made. However, he notes that if risk aversion is increased or if habit-forming preferences are introduced then the scale of the fixed cost reduces substantially. Nevertheless, it is clear that introducing market frictions alone in Luttmer's model is insufficient to resolve the puzzle; fixed costs of 5.75% of monthly consumption are far higher than could reasonably be observed in reality. Even with habit-forming preferences, it still appears that the fixed costs involved are likely to be rather high. Thus, again unless it is assumed that investors are highly risk-averse then fixed trading costs appear not to offer an adequate solution to the equity premium puzzle.

Maki and Sonoda (2002) examine the Japanese equity market using a data set of over 20 years of monthly data from January 1975 to November 1995. They report the real return for secure assets is 3%, while it is 6% for risky assets. Thus the Japanese equity premium is a mere 3% during their sample period. A model that doesn't allow for market imperfections performs very poorly and can only explain a small proportion of the observed equity risk premium. However, once trading costs are incorporated into the models they perform much better providing close approximation of the actual equity premium, with very low levels of risk aversion.

Thus the authors claim to provide an empirical solution of the equity premium puzzle if there are market frictions. Nevertheless, they concede that there is still some variation between the trading cost model results and the observed data. However, this is not the major flaw with their approach; they claim their model is based upon that of He and Modest (1995) but in actuality they fundamentally alter the model, in a manner that is difficult to understand, let alone justify. They propose that trading costs for risky assets include several components including wealth and risk factors, using these factors to estimate the bounds within which the price should lie. This is very different from the estimation technique of He and Modest and it appears difficult to understand why Maki and Sonoda have adopted the model specification they use. Maki and Sonoda infer the expected equity premium and risk-free rate from Euler equations based upon parameters of the lifetime utility function.

### 2.2.7 INCOMPLETE MARKETS

A complete market is a market where agents are able to buy or sell assets so as to protect themselves against any possible future outcome. If markets are not complete, as Mehra and Prescott assume, then this might cause there to be deviations from the behaviour our model would rationally expect. Constantinides and Duffie

(1996) point to the insurance market for unemployment being incomplete. For example, investors are unlikely to be able to fully insure against the risk of unemployment. Consequently, this will affect their preferences when they choose their investments. For example, they will strongly favour assets that have high returns in bad states when the risk of unemployment is highest. Thus, they would seek to avoid assets which offer relatively low returns in difficult economic conditions, unless they offered extremely high rates of return in other states of the world. If it could be demonstrated that equities offer poor returns during bad states then this would provide a rationale for a high (average) equity premium.

Another market that could be argued is incomplete is the borrowing market. Constantinides, Donaldson and Mehra (2002) investigate the impact of this. They suggest that middle-aged investors tend to be easily able to borrow money, but generally young investors find it much more difficult. Since 'junior' will desire to consume almost all his current income, the borrowing constraint, prevents them from being as active in financial markets as s/he would wish, in fact they claim it almost excludes young people from the market altogether. They argue that this has an important impact upon the security markets. Firstly, the young would particularly wish to borrow and invest in equities. Secondly, middle-aged investors, who are active in financial markets, aren't as attracted to equities as 'junior' would be because they suggest the correlation of equity income with consumption changes over the lifetime of an individual. Consequently, it is claimed if 'junior' didn't face a borrowing constraint then the mean equity premium would decrease while the rate of interest would increase.

Brav, Constantinides and Geczy (2002) test if complete insurance markets could rationalise the equity premium. They find that the hypothesis by itself is unable to solve the premium with plausible levels of risk aversion. However, if it is combined with the limited market participation we know exists then it does provide a solution albeit with a high level of risk aversion. Their evidence is interesting because it covers a more recent period than Mehra and Prescott's study, during which they find the premium puzzle is still in existence.

This strand of the literature poses several interesting questions. Could borrowing constraints and uninsurable income shocks really have such a large impact to justify an equity premium of this magnitude? Can agents really be so desperate to smooth their income so as to ignore such high returns on equity investments? Could stocks really be that unattractive to any agents or could any agents be so risk averse?

While there might be separate sets of investors with different preferences, such explanations still rely upon the investors most active in the market being extremely sensitive to consumption shocks in order to justify the excess returns received by equity holders. This area of research is intriguing and while it is important to analyse the impact of markets not being complete or agents being heterogeneous it doesn't appear to alter the conclusions of Mehra and Prescott. These models do not appear capable of explaining the difference in performance between stocks and bonds, without requiring investors to be extremely risk averse.

### 2.2.8 ARE INVESTORS HOMOGENEOUS? WHY DO SOME INVESTORS PARTICIPATE IN CAPITAL MARKETS WHILE THE MAJORITY DO NOT?

A further issue with the Mehra-Prescott model is that it is a representative agent model. However, there are a multitude of different agents active in any real-life economy. Furthermore, and particularly pertinent for our field of interest not all agents are active in the stock market. In fact, Mankiw and Zeldes (1991) find ¾ of individuals do not hold stocks except for pensions. Obviously, agents active in security markets should be affected by market movements much more than inactive members. Mankiw and Zeldes (1991) find individual's that hold stocks have consumption three times more sensitive to stock market fluctuations than the aggregate data and their consumption is more correlated with the equity index returns. They find that the, "implied coefficient of relative risk aversion based on stockholder consumption is only about 1/3 of that based upon the consumption of all families." Thus it is important to recognize that agents who do hold securities will be more affected by market returns than others. This should be taken into account in empirical modeling and could lead to more 'sensible' estimations of the representative agent's relative risk aversion.

Vissing-Jorgensen (2002), investigates the intertemporal preferences of asset holders and non-asset holders. She finds that asset holders have statistically and economically significantly higher elasticities of intertemporal substitution relative to non-asset holders. Perhaps, intuitively this result is unsurprising, that asset holders smooth their consumption through time much more than non-asset holders. However it demonstrates a substantial difference in intertemporal preferences between asset and non-asset holders and thus can motivate the use of asset holders consumption in asset pricing models. The implications of this are that asset holders consumption is much more volatile than aggregate consumption and thus will mean the equity premium puzzle can, ceteris paribus, be resolved with lower levels of risk aversion.

Guvenen (2005), proposes a model with two agents which features both limited stock market participation and heterogeneous elasticity of intertemporal substitution. His model suggests that with relative risk aversion of 2 an equity premium of 3.1% can be generated along with other empirical results such as a low risk-free rate that are consistent with the data. However, the equity premium estimate of 3.1%, is still somewhat short of the historical average but at least such a figure can be generated with appropriate levels of risk aversion.

Brav et al. (2002) as already referred to in the section on market incompleteness report that the combination of market incompleteness and limited market participation can aid the standard model, although such a model still requires a high level of risk aversion to resolve the model. Constantinides, Donaldson and Mehra (2002), is another study earlier referred to which examines the joint impact of market incompleteness and agent heterogeneity, which also finds such a model can reduce the level of risk aversion necessary to solve the puzzle, however, not to the extent where it really provides an adequate solution to the puzzle.

### 2.2.9 CONSUMPTION-BASED ASSET PRICING IS A FUNDAMENTALLY FLAWED IDEA?

Firstly, the consumption based asset-pricing model can be questioned on its implications regarding the way agents view investment decisions. It has been claimed that agents simply *do not* act in the manner the consumption model proposes. For example, Shiller (1999), Welch (2001) and proponents of behavioural finance would propose that agents view investment and labour income separately and they consider each in isolation for decision-making purposes. This position is based on the notion of different mental compartments developed in other social sciences.

A second cynical view, would note that the CCAPM has performed atrociously badly in empirical tests until very recently. As such maybe it should come as no surprise that the model is incapable of explaining the equity premium, since it has almost universally been close to entirely ineffective at describing financial market behaviour. In light of this, perhaps we should see this evidence as that of further failings of the consumption based model, rather than as a puzzle.

Critiques of the use of aggregate consumption in empirical models have been articulated. For instance, one such criticism relates to the use of consumption as the objective function in the economic model. Black (1990) claims that consumption data is an inappropriate proxy for wealth when used for risk purposes. This is because people smooth their consumption when their wealth fluctuates. In fact, wealth volatility is approximately three times greater than consumption volatility. Thus, it appears empirical testing so far has been flawed because it has been unable to adequately match shareholders' returns to their wealth. Since the Mehra and Prescott model implies aggregate consumption growth is too smooth to justify the historic equity premium, the use of changes in wealth instead of consumption potentially offers an important step to resolving the puzzle. Therefore, using aggregate wealth would lower $a$ to a more acceptable and plausible figure. Thus, future investigations of the equity premium puzzle could examine if using wealth fluctuations rather than consumption fluctuations then what level of equity premium could be justified given plausible parameters of other variables.

### 2.2.10 CONCLUSION

Kocherlakota (1996) argues there are only 2 theoretical rationalisations for the large equity premium. Either investors actually are much more averse to consumption risk than we thought or trading stocks is much more costly than trading bonds. In fact, neither explanation has yet provided persuasive evidence that it can resolve the equity premium using economic models. Further research into transaction costs and risk aversion are needed to provide scientific evidence that the puzzle can be resolved by either approach. There is a third possible theoretical explanation, that investors exhibit some sort of loss or disappointment aversion. However, this theory has yet to be widely recognized as a plausible explanation for the premium puzzle, largely because it is outside the realms of the consumption based asset pricing model and rests on the dirty notion of 'non-standard' investor preferences. A fourth proposed area, which could have an impact upon the puzzle is the assertion that markets are incomplete. Perhaps, heterogeneous investors facing borrowing constraints and uninsurable income shocks might have some impact upon the puzzle. However this research is still at an early stage. Furthermore, despite all the endeavours of researchers to modify the theoretical model, any resolution of the equity premium puzzle within the rational economic paradigm seems reliant upon economic agents having extremely high levels of risk aversion.

Secondly, building on the work of Mankiw and Zeldes (1991) and Black (1990), it can be suggested that empirical modelling of consumption has been flawed because it has looked generally at stock returns upon consumption, rather than examining the impact of stock returns upon stockholders' wealth. The key fact is that stockholders' wealth is much more volatile than aggregate consumption. Thus previous empirical studies would over-estimate the level of risk aversion necessary to explain the puzzle. Attempts should be made to incorporate these factors into future research, to allow a clearer picture of the state of the equity premium to emerge.

There are areas that require further research and which appear like they plausibly could have the potential to rationalise and explain the equity premium puzzle. However, the equity risk premium will remain a puzzle, for the time being, until persuasive evidence can be provided that it can be resolved in a manner acceptable to academics and practitioners. Still, it could be contended that rather than being labeled a puzzle the equity premium is actually merely additional empirical evidence of the deficiencies of consumption-based asset pricing models. If, after almost 20 years of intensive research conducted by many of the most respected and well reputed financial economists on the planet, few, if any, substantive solutions to the puzzle have been provided, then we might have to start considering an uncomfortable conclusion that the equity premium is indicative that the general approach of the consumption CAPM model employed is unsuitable and inadequate.

## 2.3 – LITERATURE REVIEW ON CALCULATING EQUITY PREMIUM

### 2.3.1 EMPIRICAL MODELING OF ASSET RETURNS

In relation to the equity premium puzzle, the case has been made that there are empirical factors which need adjustment. Firstly, with regard to the return on the relatively riskless asset. There is persuasive evidence indicating that outside the period investigated by Mehra and Prescott (1889-1978), the real rate of return on bonds has been substantially higher than the 1% found in their sample. Siegel (1992) provides reliable evidence that the risk-free rate was 3% between 1870-1890 and between 1980-1990. Thus, Ceccheti, Lam and Mark (1993) findings that the risk free rate was 2.11% for the period 1871-1987 are unsurprising. A risk-free rate of 2-3% would substantially ease the risk-free rate puzzle, as well as reduce the scale of the equity premium puzzle.

Siegel (1992, 1999) looked at real equity and bond returns between 1802-present. He reports that the annual excess returns on the stock market have risen from 2.9% in 1802-1870 to 4.7% for 1871-1925 to 8.1% for 1926-present. However, the real rate of return of equity has remained remarkably constant over time. He found the "primary source of this equity premium has been the fall in the real return on bonds, not the rise in the return on equity." The implication is that Mehra and Prescott's data might not provide a suitable estimation of the historic value of the risk-free rate or of the equity risk premium. In a historical context, it appears the period from 1926 until the new millennium has been one where an abnormally high equity premium has been observed vis-à-vis previous periods.

> Siegel (1999), "the degree of the equity premium calculated from data estimated from 1926-1980 is unlikely to persist in the future". Thus, Siegel (1999) argues "given transaction costs[3], I assume that equity investors experienced real returns of 5-6% historically rather than the 7% calculated from indices. Assuming a 3.5% real return on bonds, the historical equity premium may be more like 1.5% to 2.5%, rather than the 6% recorded by Mehra and Prescott." An equity premium of 1.5 or 2.5% with a risk-free return of 3.5% would be much more easily explained by economic models. Thus, it is possible to claim that equity premium puzzle was spurious and merely a facet of Mehra and Prescott's unrepresentative data set.

There are two major flaws in this argument of Siegel (1999), that the equity premium puzzle is spurious. Firstly, Mehra and Prescott used the longest period for which reliable consumption data was available and it was a large sample of almost 100 years. Hence, their data sample will contain useful and meaningful information about the equity premium puzzle during this period and thus their findings can't simply be disregarded and overlooked. Secondly and more importantly, it appears that Siegel is manipulating the data in an attempt to make the equity premium appear, as small as possible, or as easy to explain as possible. His use of a risk-free rate of 3.5% is very high compared to the estimate of 2.11% for 1871-1987, made by Cecchetti, Lam and Mark, which appears to be more representative. Further, reducing equity

1 Bogle (1999) estimates the costs of mutual index funds are 1-2% per annum.

returns by including transaction costs based upon holding mutual funds may not be accurate since not everybody holds mutual funds. It would certainly be preferable to incorporate transaction costs into a model to explain the data rather than make immediate adjustments to the data.

Nevertheless, for future analysis we should extend the data sample to the current time. This would include the better recent performance of bonds. It will also be important to include post-Millenium poor performance of stocks in the sample since bull market in equities of the 1980s and 1990s was one of the longest in history. This should make it easier to explain the performance of bonds and stocks during the whole sample period. It is plausible that the scale of the equity premium puzzle could be much reduced once such an extended period is used for analysis. Nevertheless, Brav, Constantinides and Geczy (2002) performed analysis on the period 1982-1996, which is outside that of Mehra and Prescott's study, but still found there was an equity premium that could only be explained with very high levels of risk aversion, once uninsurable income shocks and limited market participation had been accounted for. However, it would still be of considerable interest to see the impact that several years of sharply falling markets has had on the premium puzzle.

### 2.3.2 ARE HISTORICAL, REALISED RETURNS AN ACCEPTABLE PROXY FOR INVESTORS' EXPECTED RETURNS?

The equity premium is most commonly measured and forecasted using our observations of historical returns. However, caution should be urged upon this approach. The sheer scale of the equity premium observed historically is a puzzle for financial economists. In their seminal study, Mehra and Prescott (1985) demonstrated that the Consumption CAPM within a general equilibrium model of a pure exchange economy predicted an equity premium of less than 1% p.a. This is far less than the annual average historical premium of more than 6% p.a.; the Mehra and Prescott model can only reconcile the empirical facts with the theoretical model if investors are exceptionally risk-averse, far more risk averse than most economists would deem to be plausible. Hence an equity premium of the enormity observed historically is deemed to be a puzzle.

One of the assumptions made by Mehra and Prescott in the formulation of their model is that returns observed ex-post at the end of the sample were on average equal to ex-ante returns formed by investors at the beginning of the sample period[4]. They make this assumption in order to operationalise the model since asset pricing theory in particular is based upon investors' expectations of risk and return. However, they use historical data in order to test the model. Such an assumption is a key supposition made not just by Mehra and Prescott but rather the overwhelming majority of empirical work that tests Asset Pricing Models. Thus, the assumption that observed historical values of risk and return are on average equal to investors' expectations underpins the overwhelming majority of empirical studies in Finance. This, often implicitly made assumption, that empirical observations of risk and return are on average and in the long-run equal to investors expectations are necessary in order to operationalise the asset pricing model. However, the assumption is far from innocuous and critiques have emerged.

[4] Or prior to the beginning of each period in time.

Rietz (1988) argues that empirical observations don't fully capture agents' expectations. This is because investors may be rationally very concerned about the small chance of an economic catastrophe, such as a stock market crash, which should be included in the agent's expectations. Another example is that of 36 stock exchanges established in 1900, half experienced significant interruption or were abolished. Hence, estimated risk is biased downwards in the US because it is a survivor. When, this is incorporated into Mehra and Prescott's model, Rietz claims it can explain the high equity risk premia and low risk-free returns. He finds it can do so with reasonable degrees of time preference and risk aversion, provided crashes are plausibly severe and not too improbable. Mehra and Prescott (1988) responded to the article by Rietz claiming his, "disaster scenarios are undoubtedly extreme." Firstly, they suggest that the consumption shocks used in Rietz's study, the smallest a decline of 25% are too large, since the largest fall in US consumption in the last 100 years has been 8.8% and only 4 times has there been a decline greater than 5%. It should be borne in mind that the Wall Street Crash (1929) and following depression occurred within this period.

Mehra and Prescott (1988) also point to the fact that bondholders have not been immune to falls in return, especially if unanticipated inflation has been high. They give the examples of French and German bondholders during the 1920s and Mexican bondholders during the 1980s. Thus during economic crises, bondholders appear to suffer just as much as stockholders do, rendering disaster scenarios unable to explain the difference between bond and equity returns.

Goetzman and Jorion (1999) suggest that US market returns are subject to a survivorship bias in their study of 39 countries from around the world. They find that the US is the best performing financial market of any country and suggest that this is in part due to its economic success during the 20th Century. Therefore, how representative the US market experience is of other markets around the world is clearly an area which would benefit from further research, especially given the extremely strong performance of US equities. However, Goetzman and Jorion do not directly address the equity premium puzzle as such since they do not report how treasury bill or bondholders fared in the countries studied. Furthermore, for the premium puzzle consumption volatility is a key factor for determining the permissible area for equity premium to lie within the Hansen-Jagannathan bounds. The equity premium puzzle analysis originated based purely on US data and so further examination of this issue is necessary. It is plausible that within at least some of the countries surveyed by Goetzman and Jorion an equity premium puzzle[5] will not exist. Nevertheless, the Goetzman and Jorion study underlines the importance of examining international equity markets and considering markets outside the US.

This critical issue of how we should calculate the equity risk premium has been raised again in the literature by several recent papers. [Jagannathan, McGrattan and Scherbina, (2001), Fama and French (2002) and Donaldson, Kamstra and Kramer (2003)] They again question the usage of simply the realized historical time-series of ex-post returns. Is this the most appropriate way to establish the magnitude of the premium? Is it the best approach we have at our disposal?

It is important to examine the equity premium over extended periods of time since stock market returns are extremely volatile. Thus, estimates derived from short time periods will prove extremely unreliable. Furthermore, while the equity premium is suggested to be time-varying, particularly over the business cycle, it very much remains the case that annual ex-post returns inevitably contain a large random

[5] as defined by Mehra and Prescott (1985)

component. Such random movements in equity returns hence makes ex-post returns difficult to predict at short horizons and will mean that ex-post returns at short horizons will deviate from agent's expectations ex-ante. However, it is generally maintained that over longer horizons under the assumption that the random component of returns is mean-zero then ex-post returns should closely approximate ex-ante returns.

Black (1993, p36) however argues "if we are willing to use theory (and data other than past returns), we can estimate expected return without even looking at past returns." In recent years, deriving the expected returns implied by fundamentals has received considerable attention in the literature.

Alternative methods to estimate expected returns have emerged over recent years that uses of fundamentals such as dividends and earnings rather than historical returns. Jaganathan, McGrattan and Scherbina (2001) and Fama and French (2002) suggest that using fundamental measures to assess the scale of the equity premium are perhaps a more suitable method of assessing investor's expectations of returns. Such protagonists suggest that such fundamental models provide a figure closer to agents' true unobservable expected returns than the established method based on using ex-post returns. In usual circumstance, estimates from these alternative methods would ideally yield similar figures for the equity premium unless some event or some data abnormality has occurred to cause them to diverge.

Jagannathan et al. (2001) calculate the equity premium using the Gordon dividend discount model. They look at stock yields compared to long term government bonds yields rather than relative to treasury bills. Before 1970, they find premiums consistent with those calculated using ex-post returns. However using discounted dividends they find the equity premium has shrunk since 1970. Over the last 30 years their method indicates the expected equity premium has been a mere 0.7% p.a.. Thus their model suggests that since 1970 the expected equity premium appears to be none too different from the theoretical prediction of Mehra and Prescott's model. They suggest this could be due to dramatic technological improvements which have reduced market imperfections. For example, it is increasingly easy for investors to access information, communicate and transact with others.

Fama and French (2002) develop a different approach to estimate and analyse expected returns. They calculate the US equity risk premium from fundamental data using dividend growth[6] and earnings growth to proxy for capital gains thereby deriving a dividend based model and an earnings based model. They suggest the true level of the annual expected equity premium between 1951-2000 is likely to be closer to 2.5% or 4.4% their estimates from their dividend growth and earnings growth models respectively, rather than the 7.5% average of historical returns. The divergence of the realised equity premium from that implied by fundamentals they attribute primarily to declining expected returns during the latter part of the 20th century that stimulated unexpected growth in the market index.

Fama and French (2002) demonstrate that there is a discrepancy between average stock returns and the returns implied by discounted dividends or earnings increases. Over the second half of the 20th Century stock prices grew much more quickly than dividends or earnings. Thus, their results indicate there is a gulf between the returns expected from fundamentals and those achieved by investors. The story that is suggested for these surprising findings is that the equity premium has been inflated due to declining discount rates. The mechanism by which this occurs is that if

[6] The Gordon Discounted Dividend Model and the Fama-French Dividend Growth model are identical BUT are stimulated from different frameworks and derived in a different manner.

the discount rate falls then (ceteris paribus) expected returns will increase; consequently current stock prices will rise so that expected returns will be restored to equilibrium levels. If this occurs over an extended period, this will leave an unexpectedly large realised return in the historical data set. Thus Fama and French (2002) contend that this indicates that stock returns and thus the equity premium will be lower in the future than they have been in the past.

Fama and French (2002) also suggest accounting fundamentals such as return on investment and book to market ratio, are much more consistent with the equity premium estimates of the dividend model than the historic time-series of returns. For instance, the historical physical return on book equity is lower than the historical equity return and thus implies typical corporate investments have a negative NPV and thus shouldn't have been undertaken. This therefore implies the premium generated from realised stock returns is too high. However, the dividend and earnings growth model estimates are consistent with appropriate corporate investment decisions having been made.

However, the estimated expected returns from dividends might not be as closely linked to true *ex-ante* expected returns as we might first think. There are issues that stem from the nature of the dividend decision and there being some puzzling issues relating to why firms pay dividends. The dividend issue is arbitrary and as such it is especially susceptible to there being systematic trends in payout policy. This limitation is no doubt even more acute when looking over extended periods of time as in studies such as Jagannathan et al (2001) and Fama and French (2002).

Firstly, not all firms pay dividends anyway, so using the dividend discount model to value them is inappropriate anyway. Secondly, the proportion of US firms paying dividends declined substantially over the second half of the $20^{th}$ Century.

Fama and French (2001) themselves demonstrate that while 67% of firms paid dividends in 1978; only 21% of firms paid dividends in 1999. Since less than a quarter of US firms paid dividends in 1999 this cast serious doubts on the reliability and suitability of estimate expected returns using the dividend growth methodology of Jagannathan et al (2001) and Fama and French (2002).

Thirdly, dividends are not the only means by which firms transmit funds to their shareholders. Grullon and Michaely (2002) and Ackert and Smith (1993) demonstrate that share repurchases have become a hugely popular method by which companies distribute funds to shareholders and has grown rapidly since the 1970s; over exactly the same period that dividend payouts have declined. In fact, Grullon and Michaely show that, in actuality, the payout ratio of US companies has been effectively unchanged since 1980. Therefore, to accurately assess the expected equity premium then we need to take into account all payouts firms have made to investors and not just dividends.

Thus, the conclusions reached by Jagannathan et al (2001) and Fama and French (2002) based upon their use of the dividend growth model may prove to be unreliable. We cannot be certain that the discount rate has declined over recent years because dividends are no longer the only way in which firms redistribute their wealth to investors as the traditional formulation of the dividend growth model assumes. Thus particularly the claims of Jagannathan et al. (2001) that expected returns were as low as 0.7% p.a. since the 1970s and as thus the equity premium puzzle has largely disappeared appear to be of dubious substance and should be re-assessed on a basis which incorporates share repurchases as well as cash-dividends in the definition of "dividends".

Donaldson, Kamstra and Kramer (2003) take a different approach and try to examine the ex ante premium which is most consistent with the ex post premium and other characteristics of the US economy. They ask what is the most plausible value of the ex ante equity premium given the ex post premium, interest rates, Sharpe ratios and dividend yields? They simulate many economies over the second half of the 20$^{th}$ Century. From these simulations they find that while it is easily possible the ex post premium of 6% could have occurred with an expected (ex ante) premium of 6% it would also be statistically insignificant from an ex ante premium of 2%. However, for a high equity premium, high Sharpe ratio, low dividend yields and low interest rates to have been generated in the same economy, they find that the ex ante premium should lie in a narrow range around 4%. This would mean that the actual realised equity premium has exceeded the expected equity premium by approximately 2% per year. However, such findings would be consistent with Fama and French's proposition that (unexpected) declines in the discount rate over the past 50 years have yielded capital gains to shareholders. Thus, a situation is created where rational price adjustment inflates the equity premium measure ex post and could lead it to be substantially larger than investors' would have expected ex ante.

The approach of Fama and French (2002) and Jagannathan et al. (2001) are both backward looking attempting to help explain and understand historical phenomena which has already occurred. They are effectively asking have realised returns equalled investors' expectations during their sample period? However, a number of authors have examined a similar but nevertheless interesting question: Are historical returns a reliable predictor or at least a useful indicator of future expected returns? In other words, they try to estimate the forward-looking or prospective equity premium. Arnott and Bernstein (2002) suggest that there is also good reason to suppose that historical returns could be a poor guide to future expected returns.

"It is dangerous to shape future expectations based on extrapolating (these) lofty historical returns. In so doing, an investor is tacitly assuming that valuation levels that have doubled, tripled, and quadrupled relative to underlying earnings and dividends can be expected to do so again." (Arnott and Bernstein, 2002 p80)

Gebhardt et al (2001) look at the equity premia implied by the residual income model for the US market and industry sub-sectors. They calculate the implied rate of return based upon the constant discount rate necessary to equate future forecasted earnings and a terminal value with the current price. They provide evidence that industry membership is an important characteristic in determining a firm's cost of capital. They also find that the book/market ratio, forecasts of the firm's long-term growth prospects and the dispersion in analysts' forecasts are important variables to explain cross-sectional implied costs of capital.

Claus and Thomas (2001) use analysts' earnings estimates in order to derive conditional estimates of the equity premium. They suggest the expected value of the equity premia may be as little as 3% per annum. Whilst their paper does include an international study of the equity premium their sample period is restricted to little more than 10 years for most countries due to the availability of IBES cashflow forecasts. Hence although they suggest that conditional equity premia are small, they have only a very small sample taken from the recent bull market upon which to base these inferences.

There is an important contrast between these papers that focus on the prospective equity premium with papers that focus on the unconditional historical equity premium. The approach of Fama and French (2002) and Jagannathan et al. (2001) has a couple of key benefits. In contrast to the studies of Claus and Thomas (2002) and Gebhardt et al. (2001) which are limited by data availability of analysts forecasts to little more than 15 years of data, historical data is available for much longer periods. For instance, historical data for international markets are typically available for periods of in excess of 35 years during which financial markets have experienced periods of both bull and bear markets. Whereas prior studies of the prospective equity premium have purely analysed periods relating to the 1980s and 1990s bull market. Furthermore, studies of the prospective equity premium are based upon analysts' forecasts of future fundamentals. However, Abarbanell (1991), Abarbanell and Bernard (1992) and Claus and Thomas (2001) document that analysts' earnings forecasts are upwardly biased. Thus using these inflated growth rate projections would provide us with overly optimistic estimates of the equity premia. By using only historical data our results are free from any bias that would be induced from using analysts' forecasts.

### 2.3.3 CONCLUSIONS AND RECOMMENDATIONS

Mehra and Prescott's findings have stimulated a huge stream of research which attempt to provide a solution to the equity premium puzzle[7]. However, this

[7] Especially, modelling investor heterogeneity (see for example Maniw and Zeldes [1991], Constantinides and Duffie [1996] or Constanides, Donaldson and Mehra [2002])and alternatives to the standard power utility function (see for example Epstein and Zin [1989], Abel [1990] or Campbell and Cochrane [1999]) have received extensive attention in the literature.

review here scrutinises the assumption that historical returns are actually accurate proxies for shareholders' expected returns. If the high level of historical returns themselves are something of a conundrum then the reliability of forecasts utilising this data are going to be decidedly suspect. Since the historical equity premium has been so far below that observed in the historical data then this should lead us naturally to question whether or not historical returns is an appropriate proxy for the expected returns prescribed by theoretical asset pricing models. This is particularly so for the latter part of the 20th Century when equity markets internationally, but especially in the US performed extremely well.

Therefore at least part of the potential explanation for the equity premium puzzle can be advanced on grounds of the representativeness of the empirical data employed in such studies. Firstly, research by Siegel (1992 and 1999) and Cecchetti, Mark and Lam (1993) indicate that the historical risk-free rate is actually substantially higher than found in Mehra and Prescott's sample. Thus the inclusion of a longer time period should reduce the magnitude of the puzzle, as well as providing us with the best possible reflection of security returns.

There does appear to be a substantial gap in this strand of the literature, particularly in relation to the examination of the whether historical returns are appropriate proxies for expected returns. Firstly, the evidence generated thus far in the literature is entirely focused upon the US market, whereas nothing is known about the behaviour of other markets elsewhere in the world. This is particularly important given the findings of Goetzmann and Jorion (1999) that the US equity market's performance during the 20th Century was exceptionally strong relative to other countries equity markets. Therefore this strengthens the case for the examination of other international markets on this issue.

Consequently, in this thesis we will focus upon one of the world's other major financial markets, namely the United Kingdom. Our first major issue will be to investigate if historical returns in the UK have been considerably higher than those expected by investors over recent years as has been found by Fama and French (2002) and Jagannathan et al. (2001) for the US? If our estimates of expected returns are lower than actual returns, then the equity premium puzzle is *not* as large as has been previously documented in the literature. The difference between the expected equity premium and the theoretical prediction may not be as great as we first thought. In that instance there would be a second puzzle. Why have realised returns been so far above the expected returns implied by the earnings growth or dividend growth models?

If, in fact, expected returns have been below realised returns then this has important implications for financial practitioners who use historical returns to forecast future returns. Financial managers will utilise too high a discount rate when assessing investment opportunities and thus are likely to reject projects that would be expected to increase shareholders wealth had a more appropriate discount rate been used. Pension fund providers are likely to find the value of these funds fall below that expected by their actuaries and their clients. Likewise, Asset Managers and their clients could well be disappointed by the returns their investment portfolios produce. Therefore the results from such a study would have widespread applicability.

A second important area which appears to have received no prior attention in the literature is how representative is the aggregate market experience of the various different segments of the market. As far as I know all studies relating to the equity premium puzzle *per se* only use aggregate data. However, the model can be equally applied to the cross-section. Furthermore, it is plausible that the aggregate market results are driven predominantly by particular components of the market be it specific industries within the market or perhaps the largest corporations.

Thus an important issue and one which appears to have been almost entirely overlooked in the literature thus far is how pervasive are the aggregate results across the portfolios formed in the cross-section? This is a major insight future research should be able to offer. In this thesis we provide the first preliminary steps in this direction. We consider two main characteristics by which to categorise firms in the latter chapters of this thesis. In Chapter 4 we split firms into portfolios on the basis of industry classifications, whilst in Chapter 5 we examine size portfolios. To our knowledge, this thesis provides the first empirical examinations of the historical equity premia using the Fama and French (2002) approach to consider individual portfolios of firms.

In Chapter 4, we firstly examine if the disparity between the estimated equity premium from fundamentals and realised return over the period 1966-2002 is evident across industries. We wish to ascertain if the behaviour observed in the market as a whole is widespread amongst many industries or have the models continued to yield similar results in most industries with the disparity being due to extreme capital gains in one or two sectors. Over the last 40 years there have been industries that have grown from being tiny or non-existent on the LSE to becoming or major importance, whilst others have suffered decline. For example, the telecoms or technology industries have grown rapidly since the 1980s becoming some of the largest sectors by market capitalisation by the turn of the 21$^{st}$ century. We seek to ascertain if it is just in industries such as these, which have experienced unprecedented growth that realised returns have exceeded those implied by the dividend and earnings growth models? Or are we able to generalise the finding of a disparity between the estimates of fundamental models and historical returns across the majority of industries?

In Chapter 5, we set out with many of the same goals as in Chapter 4 except that we examine size portfolios in Chapter 5 rather than the industry portfolios considered in Chapter 4. Our first objective again will be to ascertain if there are pervasive patterns in the equity premium estimates using fundamentals or using historical return data across firms of different sizes. This is an issue of interest and pertinence, since aggregate market indices are typically examined on a value-weighted basis in studies of the equity premium puzzle. Consequently, the highest weight is firmly placed on the very largest firms, with little emphasis on smaller firms. Hence, it is quite plausible that the experience of the smaller firms in particular could differ for the picture portrayed by the aggregate market. There is also a literature on the "size premium" that there have been systematic return differences between small and large firms. Given this literature it will be of interest to apply the approach of Fama and French (2002) to these portfolios in an attempt to ascertain to what extent the equity premia earnt by individual size portfolios could be expected and the extent to which a size premium could be expected. A more detailed literature review on the size premium follows in Chapter 2.4.

## SECTION 2.4 – LITERATURE REVIEW ON THE SIZE PREMIUM

The size effect is one of the most well-known and earliest documented stock market anomaly. Banz (1981) is widely credited with the first paper identifying the tendency for small firms' shares to substantially outperform large companies. In his study he regresses individual firms' stock prices on the CAPM beta and the natural logarithm of firm size. He finds a highly statistically significantly negative coefficient on firm size. This indicates that not only do small firms tend to have higher returns than large firms, but moreover that this phenomenon persists even after market risk is controlled for. Hence, this study was also one of the first suggesting the CAPM is mis-specified.

$$r_i = \alpha_{0i} + \alpha_{1i}\beta_i + \alpha_{2i}\ln(S_i) + \varepsilon_i$$

Subsequent research by Fama and French (1992,1993,1996) demonstrated that size is a pervasive variable for explaining cross-sectional returns in the US even after other variables found to predict returns in the literature are included, such as the book-to-market ratio, earnings-price ratio or dividend yield.

In a paper published at the same time as Banz (1981)[8], Reinganum (1981) also provided evidence that small firms outperform large corporations. His approach differed from that of Banz however. Reinganum created portfolios of stocks on the basis of market capitalisation. His results indicated that the size premium, the difference between returns of the smallest and largest decile portfolios, was approximately 30% p.a.

[8] In fact in the same issue of the Journal of Financial Economics

The size effect has been found to exist in many countries around the world when examined in a manner similar to Reinganum (1981). In fact Hawawini and Keim (1995, 2000) list 13 countries representing most of the developed world where a positive size premium is identified. In essence this evidence adds considerable weight to the view that the size premium is an international phenomenon present across national borders.

Levis (1985) is the first known study to allude to a size effect being present on the London Stock Exchange. He, "documents an average 6.5% per annum premium for smaller UK firms over the period January 1958 to December 1982." (Levis (1985, p26)). More recently, Dimson and Marsh (1999) examined the performance of UK small firms relative to the FTSE All Share Index. For 1955-1986, the small cap index (HGSC) outperformed the All-share index by 6.1% p.a., whilst the micro-cap index (HG1000) had a size premium of 8.7% p.a.[9]. This further underlines the substantial difference in return characteristics of UK large and small firms.

### 2.4.1 SIZE EFFECT VARIES OVER TIME

Keim and Ziemba (2000, pxviii) note, "A characteristic of these cross-sectional patterns in returns is that their magnitude varies considerably over time."

Brown et al. (1983) using the same sample of Reinganum (1981) find "*ex ante* excess returns attributable to size are not constant through time" (p110). A view

[9] The Hoare Govett Smaller Companies (HGSC) Index covers the smallest 10% of firms by market capitalisation, whereas the Hoare Govett 1000 (HG1000) Index covers the smallest 2% of firms by market capitalisation.

supported by Keim (1983), who notes that while the size premium varies over time, it is stable within time periods. Keim points to 1974-1979 as a period of stable positive size premium and 1969-1973 as a period of a stable negative size premium. Thus he finds the premia are unstable leading him to suggest there is a, "reversal of the size anomaly" (Keim, (1983 p27)).

Black (1993) also suggests that the size premium has varied over time. More specifically his assertion is that the size effect in the US disappeared after its discovery in 1981. Dimson and Marsh (1999) suggest that for 1983-1997 the small cap premium (relative to the largest 50% of firms) had reversed that is for the post-discovery period there was a large cap premium of 2.4%, which was statistically significant. Furthermore, Dimson and Marsh (1999) find this phenomenon of a size reversal not only occurred in the US, but also in the UK. They find that following the launch of mutual funds attempting to exploit the size effect, small cap indices underperformed the all-share index by more than 6% p.a. over 1989-1997. The magnitude of the reversal in the size effect is slightly larger in the UK than the US.

Therefore there is considerable evidence that the size premium varies substantially over time (as in fact the market equity premium appears also to). Particularly, since the discovery of the size premium there is little evidence supportive that a positive and statistically significant size premium remains. Since the size effect was reported it appears to have disappeared or reversed altogether. However, even if it has reversed Dimson and Marsh (1999) assert that one should conclude a size effect still exists: i.e. the return characteristics of small stocks continue to be different from those of large.

A failing of many studies investigating the size premium is that they fail to adjust returns for systematic risk. The suggestion is that the size effect could simply be due to the higher levels of risk borne by small companies. A difficulty for such an explanation is in identifying the appropriate source of risk which small companies are exposed to.

### 2.4.2 CAPM

In terms of the CAPM there is little support for the outperformance of small stocks being due to higher exposure to the market Beta. For the US, Banz (1981) found that even after adjusting for market risk, the size effect still remains. Such findings are supported by Jegadeesh (1992) and Fama and French (1992), who demonstrate that size has explanatory power when added to the single beta model. In fact these studies suggest that firm size has greater explanatory power over the cross-section of returns than the market beta. Such results are therefore indicative that the CAPM is mis-specified.

In the case of the UK, Levis (1985) actually finds portfolios of small firms have lower CAPM betas than large firms, even after adjusting these estimates for thin-trading (using the Dimson (1979) method). Thus adjusting for market risk actually deepens the scale of the UK size anomaly. The inability of the CAPM to explain the UK size anomaly is further supported by Corhay, Hawawini and Michel (1987), who demonstrate a statistically significant positive size premium is still present after systematic risk has been adjusted for. Consequently, it appears adjusting returns for market risk is unable to explain the existence of a UK size premium. For other countries the CAPM is also limited in its ability to explain the size effect. Only in two countries out of 13 countries covered in Hawawini and Keim's (2000) literature review - France (Louvet et al. (1990)) and Canada (Berges et al. (1984)) - can systematic market risk explain return differentials between size portfolios.

However, it is far from unanimously accepted by scholars that the CAPM is unable to explain the size effect. For instance, Handa, Kothari and Wasley (1989) indicate that the US size effect is sensitive to the length of time used to estimate beta. They demonstrate that if risk is measured using annual betas then the size premium becomes statistically insignificant. Whilst, Chan and Chen (1988) argue that large measurement errors in the beta estimates, lead to the CAPM being unable to explain the size effect. This errors-in-variables problem plagues the two-step approach to estimating asset pricing models as noted by Shanken (1992), and this could also contribute to inability of market risk to explain the size effect. In actuality, using a non-parametric technique to adjust for risk, Gibbons, Ross and Shanken (1989) find no significant relationship between market capitalisation and risk-adjusted return on the NYSE. Although these studies assert that difficulties in estimating the CAPM are a major source of its inability to explain the size effect, recently the CAPM has fallen out of favour, due in large part to the emergence of multi-factor asset pricing models which appear capable of explaining many of the market anomalies including the size effect, despite such difficulties in estimating asset pricing models.

### 2.4.3 APT

The APT proposed by Ross (1976) as an alternative to the CAPM that allows for multiple risk factors, which tend to be economic risk factors. Chen (1988, p183) suggests that economic risk factors might be able to explain the size premium because, "small firms tend to be marginal firms, they fluctuate more with business cycles, and thus have higher risk exposure to the changing risk premium." An early empirical investigation of the APT in the US by Chan, Chen and Hsieh (1985) finds that after adjusting for economic risk the size premium is little more than 1% p.a. and is statistically insignificant from zero. This leads them to suggest "the firm size anomaly is essentially captured by a multi-factor pricing model. The higher average returns of smaller firms are justified by the additional risk borne in an efficient market" (Chan et al. (1985 p469)). These results support the prior findings of Chen (1983). However, a more detailed study by Lehman and Modest (1988) that employs a similar methodology to Chan et al. (1985), but looks at 5 or 20 size portfolios provides results contradictory to Chan et al. (1985). Lehman and Modest (1988 p253) comment, "the size (and turn-of-the-year) effects have thus far evaded a satisfactory risk-based explanation." A view which is supported by Shukla and Trzcinka (1990) who also find the APT unable to explain differences between large and small firms. Clearly a solution to the size premium that appears to depend upon the number of size portfolios used for empirical analysis is unlikely to receive widespread acceptance. Why does the APT only explain the size effect across size deciles, but not size quintiles or 20 size portfolios?

There are a number of methodological issues with these empirical investigations of the APT. Firstly, the APT specifies that risk factors should be unexpected movements in the specified variable. Studies such as Chan et al. (1985) use the simplistic approach of assuming that any change in the economic variable is unexpected. This seems to be a rather unrealistic assumption and more sophisticated methods have been used in more recent studies to generate these unexpected components, such as time-series models or kalman filters. A second methodological critique is that these asset pricing studies also use two-step approach to calculating the model which means it too can be plagued by concerns of errors-in-variables bias. Therefore finding the appropriate measure of the unexpected component of the series will be a key issue for future research examining if the size premium can be explained by the APT.

As a matter of fact this appears to be a fertile area for future research. There are very few if any published studies that the author is aware of that seeks to explain the size premium using the APT outside of the US and thus an international study of the issue appears to be overdue.

### 2.4.4 SIZE PROXIES FOR AN UNOBSERVABLE RISK-FACTOR

Fama and French (1993, p4) contend, "that if assets are priced rationally, variables that are related to average returns, such as size and book-to-market equity, must proxy for sensitivity to common (shared and thus undiversifiable) risk factors in returns."

Thus they argue that the generally higher returns of smaller firms is due to exposure to systematic risk factors outside the scope of established asset pricing models. A proposition is that firm size could proxy for relative distress. He and Ng (1994) and Shumway (1996) provide evidence that this is related to delisting from the stock exchange. Dimson and Marsh (1999) find that there cases of small UK firms becoming valueless every year, although even at their peak such companies account for just 1% of the small-cap index by market capitalisation. Thus, this doesn't appear sufficient to explain the UK size premium.

Another explanation is proposed by Knez and Ready (1997). They find the "negative relation between firm size and average returns is driven by a few extreme positive returns in each month." (Knez and Ready (1997 p1376)). The return distribution is positively skewed, especially for small young firms. Their results suggest investors hold small firms anticipating a few major successes and a few minor disappointments. "The idea that such firms should carry a risk premium is sensible" (Knez and Ready (1997 p1380)). Their suggestion regarding disappointments is similar to the distress risk conjecture of Fama and French (1992). However, Mackinlay (1995) is sceptical that omitted risk factors can be priced sufficiently highly to rationalise the observed size premium. An important point is that while size might be priced as a risk factor, this gives little or no insight into the economic factors causing this cross-sectional variation. Until a convincing and demonstrable theoretical and empirical link between firm size and an economic factor it will not be widely accepted as a risk proxy.

### 2.4.5 FIRM SIZE AND THE JANUARY SEASONAL

Keim (1983 p19) found, "that nearly fifty percent of the (size) anomaly is concentrated in the month of January". He reports, "The relation between abnormal return and size is always negative and more pronounced in January than in any other month." (Keim (1983 p31)). In a following paper covering a longer sample period of

US data Keim (1990 p60) finds, "there is no size effect outside of January". This analysis appears to have been accepted, for example in a leading textbook Bodie, Kane and Marcus (1996 p348) comment, "The size effect is in fact a 'small-firm-in January' effect". Thus for the US the size effect appears to be a seasonal effect. However this is still perplexing that such a pervasive pattern in stock returns should be found and stimulates two vital questions. Firstly, why should there be a size premium in January? Secondly, how well does the small-firm-in-January effect explain the size effect in international markets?

For the UK the size effect appears to be distinct from any seasonal effect, thus the small-firm-in-January effect found in the US doesn't appear to travel well. Although, Priestley (1997) does find there is seasonal variation in UK asset prices, January carries a negative premia as does the tax year end, April. Dimson and Marsh (2000) provide similar analysis commenting that the UK size anomaly cannot be explained by seasonality and thus their evidence corroborates Priestley (1997). Both papers thus suggest results inconsistent with the US evidence and thus it appears there are some major differences in the nature of the UK and US size premia.

### 2.4.6 OPERATIONAL EFFICIENCY EXPLANATIONS

Explanations for the size premium have been advanced on the premise that capital markets are less operationally efficient for small firms than for large corporations. For example, small stocks tend to be relatively illiquid and thinly traded compared to those of large corporations (Foerster and Keim (2000)). Roll (1981) argued that the size effect may have resulted from improperly measuring risk due to the infrequent trading of small stocks. However, there are examples amongst the literature where CAPM beta's have been estimated using methods designed to account for nonsynchronous and infrequent trading (such as Scholes and Williams (1977) and Dimson (1979). In the US, Reinganum (1982) and Hawiwini and Keim (1995) estimate beta this way, while in the UK Levis (1985) did so. These papers unaminously reject the conjecture that thin-trading causes errors in estimating market risk that can explain the size premium. They conclude a size premium remains evident.

Stoll and Whaley (1983) and Knez and Ready (1996), amongst others, have argued that there are larger transaction costs involved in managing a portfolio of small firms relative to large companies. Aiyagari and Gertler (1991) argue that the bid-ask spreads tend to differ substantially between large and small companies, and so consequently do trading costs. They find that spreads average 0.5% for the largest 50%, but increase to an average of 1% for the smallest 50%, however, for the very smallest firms the spread can be more than 5%. An alternative method to examine the transaction costs is by analysing the performance of a market index relative to a passive tracker fund, since the fund incurs transaction costs whilst the index does not. Keim (1999) finds that such transaction costs are modest in the US, which is supported by Dimson and Marsh (1999) for the UK, where such costs are estimated to be 0.37% p.a. Clearly transaction costs of such a paltry magnitude are unable to explain a size premium that averages more than 6% p.a.

### 2.4.7 DATA MINING

Lo and Mackinlay (1988, 1990), amongst others, argue that anomalies in cross-sectional asset returns based on relationships where there is no obvious economic justification, may be the result of data mining. Fama (1991 p1575) provides an illustration of such an argument, "with many clever researchers, on both sides of the efficiency fence, rummaging for forecasting variables, we are sure to find instances of 'reliable' return predictability that are in fact spurious ... evidence of predictability should always be met with a healthy dose of scepticism." Anomalies such as the size effect could be claimed merely to be, "accidental patterns in historical data" (Campbell (2000)).

Black (1993) suggests that, "Most of the so-called anomalies that have plagued the literature on investments seem likely to be the result of data-mining. The researcher who finds (a profit opportunity) writes it up, and we have a new anomaly. But it generally vanishes as soon as it's discovered." Black asserts that it is exceptionally difficult to make abnormal returns from using trading strategies based upon anomalies. This point is endorsed by Ross (1994) who has, "attempted to exploit many of the seemingly most promising 'inefficiencies' ... but has never yet found one that worked in practice." Again these scholars would contend that these findings of return predictability were purely chance, spurious discoveries and that such relationships are not actually apparent in the true return generating process.

Such an argument appears applicable to the size effect since recent research has suggested that this particular anomaly has disappeared or reversed since its discovery (see Dimson and Marsh (1999) and Horowitz et al. (2000)). Contemporary empirical evidence appears to provide out-of-sample rejection of previous research indicating a positive size premium. Therefore, it could be construed that initial researchers were guilty of data-mining and their findings of 'anomalies' were simply mistakes which disappeared once they were published.

### 2.4.8 OTHER ALTERNATIVE EXPLANATIONS

A plethora of other explanations for the size effect have been advanced. Berk (1995) argues that for two firms with identical expected cashflows if agents are risk averse then the firm with the more volatile cashflow will have a lower market value (be smaller) and have higher expected earnings per share, and thus have higher expected returns. Thus Berk claims the size premium can be explained within the existing finance paradigm. However, this analysis relies crucially upon the assumption of no positive correlation between expected returns and expected cashflows, when expected cashflows vary. In reality empirical studies find that there is a positive relationship between expected returns and expected cashflows. For instance, Lettau and Ludvigson (2005) advance this as a reason for the inability of the dividend-price ratio to predict future cashflow growth.

Other examples of potential explanations for the size effect include Arbel and Strebel's (1983) suggestion that small firms are relatively neglected and thus the premium can be justified by their higher information costs. While, Dimson and Marsh (2000) suggest that size portfolios have differing exposure to industry sectors, which could explain part of the premium. They also suggest relative dividend growth might be able to explain some of the premium. Others still suggest the size premium could be linked to merger activity because small firms are more likely to be merger targets and merger targets tend earn large excess returns prior to takeover completion.

### 2.4.9 SUMMARY OF SIZE PREMIUM LITERATURE

There is a high degree of controversy and disagreement within both practitioner groups and academics alike over the differing explanations for the size premium. This debate is one which has yet to be adequately resolved, which in part stems from the lack of strongly persuasive evidence in favour of any of the competing explanations.

Finding a rational explanation for the size premium prior to 1980 is made difficult by the more recent evidence that has emerged of a disappearance or reversal in the size premium since its discovery by Banz (1981). These analyses are necessarily based upon a limited sample length. For instance the UK size premium reversal documented by Dimson and Marsh (1999) focuses only on 1989-1997. Given such a short period of analysis a further examination is justified to examine whether such a reversal is still evident when the sample is extended to cover the recent bear market.

Although many of the possible explanations for the size premium have been systematically and extensively investigated, we notice there is little prior evidence examining the fundamental performance of small firm portfolios relative to large firms. This is an opening in the literature that we intend to exploit and fill part of the gap by providing some empirical evidence from the UK market. This will enable us to examine the general question as to whether or not the past size premium could have been expected on the basis of fundamental growth differentials between portfolios. However, we anticipate that by extending our sample period through to the beginning of the new millennia this will enable us to shed new light on the recent behaviour of the size premium. This will enable us to provide further evidence on and to re-evaluate the behaviour of the size premium since its discovery that may re-inforce or challenge earlier studies which were based on a rather limited sample size.

An additional important finding of this review is the dearth of literature examining whether or not the size premium can be explained by multifactor asset pricing models. This is particularly true of the UK where there seems to have been no previous research of the ability of APT economic risk factors to explain the size premium. There is also little evidence in the UK that reports the nature of the size premium across size deciles or that re-examines if the market model can explain the return differentials between large and small stocks.

## 2.5 LITERATURE REVIEW CONCLUSION

In this Chapter we have surveyed various strands of literature related to the topics covered in this Thesis. We began with an overview of the equity premium puzzle drawing upon the seminal work of Mehra and Prescott (1985). The analysis of Mehra and Prescott (1985) demonstrates that a theoretical economic model under reasonable parameterisations predicts an equity premium that is far too small compared with historical data.

Following Mehra and Prescott (1985), the assumptions made in their analysis have been relaxed or adapted in various ways in hope of providing a solution to the puzzle. For example, theoretical models that allow for heterogeneous agents or market incompleteness or different forms of investor preferences have been examined. Therefore, modifications to the theoretical model proposed by Mehra and Prescott (1985) have been extensively investigated and have thus far failed to provide an adequate solution to the equity premium puzzle. In other words, a solution has yet to be found which does not require investors' to be extremely risk averse. In this thesis, we therefore follow a different approach.

This thesis considers the empirical modelling of the equity premium rather than dealing with theoretical issues relating to the equity premium puzzle. An important assumption made, not just by Mehra and Prescott (1985), but in numerous studies within financial economics is that equity returns on average and in the long run equal investors' expectations. However, little prior research has been undertaken examining the reliability and suitability of this assumption. A notable exception to this is the work of Jagannathan et al. (2001) and Fama and French (2002). In this thesis we build on these prior studies and use the framework of Fama and French (2002) to examine the UK Equity Premium.

Fama and French (2002) argue that if dividends and prices are in a stable long-run relationship then dividend growth provides an approximation of expected price appreciation. Similar intuition would apply to other variables in a long-term relationship with prices such as earnings or even consumption. Fama and French (2002) argue that since 1951 the actual equity premium has been above that implied by either dividends or earnings. In other words their analysis suggests that for 1951-2000, the historical equity premium is a poor proxy for the equity premium that could have been expected in 1951.

Little prior analysis has been conducted on the long-term UK equity premium (Dimson et al. (2003) and Campbell (1996, 1999, 2003) being the most notable exceptions) despite London being one of the world's major financial centres.

This thesis bridges some of the gaps in the current literature on the UK equity premium. Firstly in Chapter 3 it examines whether the historical UK equity premium tends to be a good proxy for the expected equity premium at the *aggregate* level. The later empirical Chapters of this thesis build upon the aggregate analysis of Chapter 3 by highlighting the driving forces during periods when historical equity premium are imprecise proxies for the expected equity premium. In Chapter 4 we consider whether a disconnection between historical equity premium and the expected equity premium is pervasive across almost all industries or whether it is driven by a few particular industries.

The literature on the size premium has also been reviewed since in Chapter 5 we estimate expected equity returns across size portfolios. The review on the size premium has highlighted some of the purported sources of the size premium as well as the recent debate over whether or not it still exists following its discovery. Possible explanations for the size premium include that it is due to risk, liquidity, transaction costs or seasonality. Given that the central theme of this thesis is the equity premium it is not plausible for us to assess or re-examine these explanations. However, there are gaps in the UK literature on the size premium that we intend to exploit in Chapter 5 in order to shed light upon the equity premium attained by firms of differing sizes. In particular, one possible explanation for the size premium is that it is expected, in the sense that small firms, on average, generate faster fundamental growth than large firms. In relation to the proposition that the size effect has disappeared since its discovery, a weakness of the UK literature is that prior studies (such as Dimson and

Marsh (1999)) cover only very short periods of time. Furthermore an explicit examination of the possibility that the changing nature of the size premium reflects changes in expected equity premia has not been conducted. More generally this analysis of the equity premium across size portfolios enables us to identify if for all size groups the historical equity premium is a poor proxy for expected equity premium or if this is only apparent for specific size groupings. These are the major issues addressed in Chapter 5 of this thesis.

# CHAPTER 3: THE EQUITY PREMIUM: 101 YEARS OF EMPIRICAL EVIDENCE FROM THE UK.

## 3.1 INTRODUCTION

The Equity Premium is the reward in terms of the extra return that investors demand for holding risky assets rather than risk-free assets. The Market Equity Premium is usually measured as the difference in return between a stock market index (such as the S&P 500 in the US or the FTSE All Share in the UK) and a short-term Treasury-Bill or Long-term Bond Rate.

"The Equity Premium is perhaps the single most important number in financial economics" remarks Welch (2000, p501). The Premium is of paramount importance and plays a central role in Finance partly stemming from the numerous applications it has within the field. Financial managers use it for investment appraisal, cost of capital estimation and financing decisions, investment analysts rely upon it for portfolio asset allocation and investment performance evaluation, while actuaries require an accurate estimate for determining pension fund contributions and projecting pension payouts.

Given the pivotal role of the equity premium in finance it is perhaps surprising that Welch (2000) notes there is no consensus upon how it should be estimated. Rather several different methods have been proposed and applied by practitioners. A popular method to estimate the equity premium is to use historical realised excess returns observed ex-post. This method has the benefit that data is easily observable and readily available. However as Mehra and Prescott (1985) demonstrate the magnitude of these returns are a puzzle and cannot be reconciled with those implied by economic theory using a Consumption Capital Asset Pricing Model (CCAPM). Perhaps, part of the puzzle is due to asset pricing theory being based upon expected returns but being tested using realised returns. The empirical results of Mehra and Prescott (1985) and subsequent studies rely upon the assumption that investors expected returns in the long run and on average will equal realised returns. If this assumption doesn't hold then testing asset pricing models using historical returns is inappropriate and provide unreliable results.

An alternative method is to attempt to examine expected returns more directly. This can be undertaken by using fundamentals such as dividends in order to estimate the expected return investor's could anticipate, as demonstrated by Fama and French (2002) and Jagannathan et al (2001). The empirical analyses of Fama and French and Jagannathan et al indicate that in the US, realised returns have been substantially above the expected returns implied by fundamentals during the latter part of the 20$^{th}$ Century.

The motivation of this study is threefold. Firstly, this study provides estimates of the expected UK equity premia implied by fundamentals using data covering the entirety of the 20$^{th}$ Century. We use the dividend growth model approach outlined by Fama and French (2002) to derive this estimate of expected returns and compare our results with the historical ex-post returns received by investors. We are unaware of any previous empirical studies that have been conducted outside the US, which have examined expected returns directly over such a long sample period. In fact, there is a dearth of empirical research conducted outside of the US market on the equity premium that spans the whole of the 20$^{th}$ Century. A notable exception is Dimson, Marsh and Staunton (2003) who provide some international evidence that historical returns were higher in the second half of the 20th Century than the first. However Dimson et al. (2003) focus purely upon realised returns. In contrast, the focus of this paper is upon expected returns and any discrepancy between realised returns and expected returns.

We propose that our method of estimating expected returns, the Fama-French dividend growth model, can be more appropriately applied in the context of the UK market than the US. This is because American corporations seem to have made substantial changes to their payout policy, which could substantially affect the results from this model, while similar changes appear not to have been made by British firms until much more recently. Recent research by Grullon and Michaely (2002) has documented that since the 1970s: a) The US dividend payout ratio has declined substantially and b) Share repurchases by US firms have become an increasingly important means to distribute funds to shareholders. Such changes in payout policy could induce a downward bias upon equity premia estimates implied by dividend growth. However, these trends are much less apparent in Britain. Rau and Vermaelen (2002) present evidence that until the late 1990s share repurchases by UK firms were negligible and Ap Gwilym, Seaton and Thomas (2004) document that the UK aggregate payout ratio in December 2001 was above its historical average for 1962-2001. Thus, the UK market is better suited than the US for the implementation of the dividend growth model for estimating equity premia.

Thus, we examine in the context of more than 100 years of UK data if there is a disparity between the historical realised equity premium and the equity premium implied by dividends. The discrepancies uncovered in this study between realised returns and expected returns implied by fundamentals raise important issues as to their source. Campbell (1991) demonstrates that any deviations of realised returns from expectations can be prescribed to either a change in expected dividend growth or a change in expected returns or both.

Secondly, the predictability of aggregate dividend growth is an important issue given the deviations between realised and expected returns uncovered by our initial investigation of the equity premium in Chapter 3.3. This is because revisions in expectations of future dividend growth could potentially provide an explanation for the difference between expected returns and realised returns. Dividend growth predictability is also a topic which appears to have received relatively little attention in the literature. We seek to establish which factors are related to aggregate dividend growth and can explain the considerable time-variation that exists in dividend growth. In this paper we focus on the ability of the dividend-price ratio, lagged dividend growth and lagged returns as a potential predictor variables for dividend growth. Our analysis is conducted by means of both in-sample predictability and out-of-sample forecasting power.

Finally we examine if there has been a permanent shift in the time-series of expected returns. Several recent articles have posited that future expected returns for the early 21st Century are lower than past realised returns (see e.g. Claus and Thomas [2001], Arnott and Bernstein [2002]). We seek to provide additional evidence on this issue by exploring the behaviour of the dividend-price ratio and investigating evidence from structural break tests. The dividend-price ratio is important in its own right since it provides important information regarding the income yielded by portfolios from dividend payments. However, it has also been an important variable for predicting future returns and thus capital gains as documented by Fama and French (1988) and Campbell and Shiller (1988). Thus, we contend that any permanent change in the time-series of the dividend-price ratio will be especially informative with regard to future expected returns.

Why could a change in expected returns lead to a run-up in share prices? The argument is that if equities are valued according to the discounted value of their future cashflows then a fall in expected returns (the discount rate) will lead to an increase in fundamental value. This theory therefore relies on the presence of arbitrageurs in the market, who once they observe a fall in discount rate will purchase equity at its original price and then hold the equity until they are willing to sell at the new higher equilibrium price. The arbitrageurs thus will make a riskless profit in the process.

Our analysis differs from that of Fama and French (2002) in important ways; specifically in terms of how we seek to explain the divergences that occur between historical returns and expected returns. Firstly, we examine whether fundamental growth can be forecasted in more depth than Fama and French (2002). We compare the performance of regression models with the historical average, which lends support to the case that the historical average is the best forecaster. Secondly, we examine precisely when the fall in expected returns by using structural break tests. This allows us to observe when the dis-connect between historical and expected returns occurred. Hence in particular in dealing with these two main issues we adopt a more detailed and rigorous approach than Fama and French (2002).

Have historical returns in the UK been considerably higher than those expected by investors over recent years as found by Fama and French (2002) and Jagannathan et al. (2001) for the US? If so, then *ex-post* measures of the equity premium puzzle will overstate the magnitude of the puzzle. The *ex-ante* equity premium measured using fundamentals may be considerably smaller than the 6% it is frequently quoted to be. Thus, the difference between the expected equity premium and the theoretical prediction may not be as great as we first thought. However, there may be a second puzzle. Why have realised returns been so far above the expected returns implied by the dividend growth models?

## 3.2 MODEL AND DATA DESCRIPTION

In this section we first outline the models used in this chapter, we then proceed to describe the data utilised in this study before assessing the statistical properties of this data. Finally we examine in detail the methodologies utilised throughout this chapter.

### 3.2.1 MODEL

In finance, the return in any time period is given by equation 1. The simple proportional return ($R_t$) is the dividend paid ($d_t$) during that time period plus the change stock price ($p_t$-$p_{t-1}$) during that time period expressed as a proportion of the original asset price (at prior time period t-1).

Simple Return Equation

$$\begin{aligned} R_t &= (d_t + p_t - p_{t-1})/p_{t-1} \\ R_t &= d_t/p_{t-1} + (p_t - p_{t-1})/p_{t-1} \end{aligned} \qquad (1)$$

In (1) we can separate the proportional return ($R_t$) into two distinct parts. The first part is the dividend yield ($d_t / p_{t-1}$) which is the dividend paid during the current time period t divided by the original asset price at time t-1. The second is the proportional capital gain ($p_t$ - $p_{t-1} / p_{t-1}$) given by the change in price between time t-1 and t divided by the original asset price.

This chapter focuses upon the expected equity premium following the approach of Fama and French (2002) to derive estimates of average stock returns. In their average return model, the average stock return ($R_t$) is simply the average dividend yield ($d_t$ / $p_{t-1}$) plus the average growth of prices ($GP_t$).

Average Return Model

$$A(R_t) = A(d_t / p_{t-1}) + A(GP_t) \tag{2}$$

Equation 2 shows the average return model, where *A ( )* is the arithmetic average, $d_t$ is real dividend payments during the current time period t, $p_{t-1}$ is the price index at the previous time period t-1 and $d_t$ / $p_{t-1}$ is the dividend yield. $GP_t$[10] is the proportional capital gain in time t as defined in equation 2.

If the dividend-price ratio ($d_t$ / $p_t$) has a constant mean then over extended periods of time the proportional change in equity prices must be matched by an almost equivalent proportional change in dividends. Since a constant mean is one condition that stationary variables must satisfy, it follows that if we have a stationary dividend-price series then dividend growth will give us an estimate of the expected growth of the share price. Consequently, we can obtain estimates from fundamentals of expected capital gains.

[10] $GP_t = (p_t - p_{t-1}) / p_{t-1}$

Similar intuition applies to any other variable that is in a long-term stable relationship with prices. Other possible suitable candidate variables might be earnings or consumption. However reliable data, especially for earnings dating back to 1900 is unavailable for the UK market. Hence we only consider the dividend growth model outlined in (3).

Dividend Growth Model

$$A\ (RD_t) = A\ (d_t\ /\ p_{t-1}) + A\ (GD_t) \tag{3}$$

In Equation 3, $RD_t$ represents the dividend growth model estimate of expected return and $GD_t$ represents the proportional dividend growth.

The Fama-French Dividend Growth Model is defined in (3) as the return of the dividend model ($RD_t$) being given by the average dividend yield ($d_t\ /p_{t-1}$) plus the average dividend growth rate ($GD_t$)[11].

This approach benefits from its generality and its simplicity. It relies upon very few underlying assumptions. The main assumption made thus far has been that the ratio of dividends or earnings to price is stationary. Since, then dividend growth or earnings growth will provide the researcher with an estimate of capital gains. In fact, these fundamentals should provide us with a more precise estimate of the expected equity return in any one year due to dividends and earnings fluctuating less erratically than stock price indices. However, if the valuation ratios are the same at the sample beginning and end then the average equity premium yielded by each method would be identical.

Even if the series are not stationary, Fama and French (2002) claim their approach can still be employed provided the weaker condition that the series is mean-

[11] $GD_t = (d_t - d_{t-1})/d_{t-1}$

reverting or mean-reverting during each regime. They make the case that one can rationally expect there to be different regimes in the valuation ratios, primarily brought about because of permanent or highly persistent changes in factors determining asset prices. For example, if investors believed growth of fundamentals to have permanently increased then prices would rationally shift upward perhaps causing the appearance of a non-stationary section in the dividend-price ratio. Therefore, as long as valuation ratios exhibit mean-reversion during regimes it is posited that dividend growth and earnings growth will provide reasonable approximations of capital gains and the models developed by Fama and French can be employed.

Actually, when there are price shifts caused by rational factors that could not be foreseen then Fama and French (2002) suggest that fundamentals are a superior way to estimate expected equity returns. Since, in the preceding example the increase in the growth rate was unexpected, investors' returns would be inflated due to the equity price rise which was due to good fortune in terms of unanticipated favourable economic news.

This, however, poses a challenge for the researcher to demonstrate that their use of the dividend model in the place of any non-stationarities in the data can be justified on the basis of rational price adjustment to unanticipated factors. If movements in valuation ratios were caused primarily by factors other than rational price adjustment, such as market optimism or mis-pricing then the Fama-French model may prove to be an inappropriate abstraction of reality and yield defective results. Hence in section 3.2.5 we address these issues in detail not only conduct simple unit-root tests but also examine advanced econometric methods to establish when the valuation ratios are stationary and during which periods, if any, they were non-stationary.

### 3.2.2 EQUIVALENCE OF FAMA-FRENCH AND GORDON DIVIDEND GROWTH MODELS

The Fama-French Dividend Growth model outlined in Section 3.2.1 is equivalent to the classic Gordon (1962) dividend valuation model. Traditionally, the Gordon model gives you the constant return on equity implied by the current price, current dividends and dividend growth rate at any one point in time. In a multi-period setting simply taking an average of this would give us the result Fama and French produce in equation 3. However, the basis of each model is quite distinct and each originates from markedly different backgrounds, as illustrated by the derivation of the Gordon model.

In this model share prices are determined by equating the current price to investor's expectations of the assets' future cashflows discounted to the present time. Consequently the current share price ($P_t$) is determined by the value of the dividend paid during the next period ($D_{t+1}$) and the asset price at the end of the next period ($P_{t+1}$) discounted (at rate $k$).

$$P_t = \frac{D_{t+1} + P_{t+1}}{(1+k)} \tag{4}$$

In the same way the price at the end of period one is given by the dividend expected during period two plus the price expected at the end of period two both discounted back to period one as shown in equation 5. If we now substitute this into the initial pricing equation then price at time t is given by the discounted dividends paid during periods one and two plus the discounted asset price at the end of period two. Assuming the cost of capital is constant we arrive at equation 6.

$$P_{t+1} = \frac{D_{t+2} + P_{t+2}}{(1+k)} \tag{5}$$

$$P_t = \frac{D_{t+1}}{(1+k)} + \frac{D_{t+2} + P_{t+2}}{(1+k)^2} \tag{6}$$

If one continues to substitute recursively for the future price then the current price is given simply by the discounted stream of future dividends that the asset held pays. Thus, as shown in equation 7, an infinitely lived company can be valued simply according to the discounted stream of future dividends that it is believed to pay.

$$\begin{aligned} P_t &= \frac{D_{t+1}}{(1+k)} + \frac{D_{t+2}}{(1+k)^2} + \ \dots \ + \frac{D_{t+\infty}}{(1+k)^\infty} \\ P_t &= \sum_{i=1}^{\infty} \frac{D_{t+i}}{(1+k)^i} \end{aligned} \tag{7}$$

If we now assume that the asset pays a dividend that grows at a constant rate then the dividend series follows a geometric progression that can be solved for price and re-arranged to be expressed in terms of the required rate of return.

$$\begin{aligned} P_t &= \frac{D_{t+1}}{k-g} \\ k &= \frac{D_{t+1}}{P_t} + g \end{aligned} \tag{8}$$

In equation 8, $k$ is the required return on equity and $g$ is the growth rate.

If we determine the growth rate ($g$) by the proportional growth of dividends during the current time period and take the average of equity return calculations, then the Gordon Dividend Discount model and the Fama-French dividend discount model are identical.

Thus, the Gordon Dividend Discount model gives us an alternative way to derive an expression for the return on equity implied by dividends that is equivalent to the Fama-French Dividend Growth model. However, the assumptions we have made in deriving these models are quite different. The Gordon model assumes that the rate of return investors' expect is constant, that the company will pay dividends forever and thus must have an infinite life and that the dividend payment will grow at a constant rate. The empirical validity of these assumptions can be questioned. For example, there is substantive evidence that suggests expected returns fluctuate over the business cycle. The assumption that the dividend growth rate will be constant is also unlikely to hold exactly varying according to the stage of the business cycle and the industry lifecycle. Whilst an estimate can be approximated for the growth rate, a further drawback of the dividend growth approach is the sensitivity of the required return to the growth rate used.

Furthermore, in this present-value model, the dividend yield is theoretically a stationary time-series, thus if empirically we were to discover the dividend yield had non-stationary properties then the Gordon dividend discount model will not hold and this would be an invalid approach to employ.

The underlying motivation of these two models is also very different. For example, the Gordon dividend growth model is only valid under the assumption that the asset price is determined by the sum of all future dividend payments discounted back to the present. The Fama-French dividend growth model presented above is valid even if asset prices are determined by an alternative model rather than according to agents' expectations of future discounted dividends. In this respect, the Fama-French model can be seen as being much more general.

However, the Gordon dividend discount model does have an important advantage. It doesn't stipulate how the growth rate ($g$) should be calculated in contrast to the set way in the Fama-French formulation. Thus it allows for some flexibility in determining the appropriate growth. For example, averages of the last 5 years dividend growth rate is often employed, or alternatively analysts' 5 year forecasts are commonly employed. This flexibility has two main benefits. Firstly, practitioners can choose the method to measure of the growth rate they believe to be most applicable. Secondly, if the estimates of longer than 1 year are used to calculate the dividend growth rate then it will fluctuate less and thus as a result be more precisely estimated.

### 3.2.3 DATA DESCRIPTION

Our data for the sample period 1900-2002 are taken from the Barclays Equity-Gilt Study[12] and is referred to henceforth as Barclays data. It covers firms listed on the London Stock Exchange. Since 1962 the data is derived from the FTSE All-Share Index. The Barclays equity index for the period 1900-1962 comprises the 30 largest shares by market capitalisation in each year and is rebalanced annually. The Barclays equity-price index is value-weighted with the weights of constituent companies being proportional to their market capitalisation. The income yield on the index is derived

[12] The authors gratefully acknowledge the help of Barclays Capital and in particular Judith Anthony for providing a copy of the Barclays Equity-Gilt Study.

from all the dividends actually paid by companies during the relevant year divided by the year end price $(D_t/P_t)$. In this study we refer to this ratio as the dividend-price ratio. We define the dividend yield as the dividend paid during the current year expressed as a proportion of the prior years price $(D_t/P_{t-1})$. In addition to the equity price index and income yield, we also collected by hand from the same source the treasury bill index and cost of living index. We use the cost of living index as a proxy for the consumer price index when calculating inflation. The data gathered thus provides us with all the information necessary to enable us to estimate the average return model and the dividend growth model.

In this study we examine the data in real terms, although our methodology is equally applicable to nominal values. Our preference for real terms stems from the basic tenet of financial theory that investors' primary objective in investing is to transfer consumption from one time period to another. Therefore, we are not primarily concerned with the nominal monetary value of our assets but rather with the consumption stream that this monetary income will entitle us to. This provides us with the rationale for looking at all variables in real terms, thereby investigating the model's implications for the purchasing power of investors' income.

We construct the real values of our series collected in nominal terms by adjusting for inflation in the following manner:

$$r = (1+R)/(1+h) - 1 \tag{9}$$

where $r$ is the real growth rate, $R$ is the nominal growth rate and $h$ is inflation.

### 3.2.4 DESCRIPTIVE STATISTICS

Descriptive statistics for all the data series were generated using the PC-Give software package. This included calculating mean, standard deviation, skewness and kurtosis values, plotting histograms of the data as well as testing diagnostically for normality.

The Jarque-Bera test is commonly used to assess if a data series is normally distributed. If a data series were found to be non-normally distributed then this causes difficulties when regression analysis is undertaken. Specifically, conventional distributions of test statistics are generally formed under the assumption that a series is normally distributed, thus if a series is not normally distributed then adjustments to critical values should be made for reliable hypothesis testing to be undertaken. Whilst this is the case the unbiased and minimum variance properties of the estimator are unaffected. Even in the presence of non-normally distributed data the annual equity premia calculations in Section 3 will be completely unaffected.

Jacque-Bera (JB) test statistic

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right] \tag{10}$$

In equation 10, n is the number of observations, S is the coefficient of skewness, K is the coefficient of kurtosis. The normal distribution has a skewness coefficient of 0 and a kurtosis coefficient of 3, so K-3 measures excess kurtosis. Thus, the Jarque-Bera test statistic provides us with an indication of how close the series is to being normally distributed in terms of skewness and excess kurtosis. If the series is exactly normally distributed the test statistic will be 0. The further the sample skewness and kurtosis coefficients are from the theoretical normal distribution the lower the probability that the sample data is drawn from a normal distribution.

The Jarque-Bera critical value follows the $\chi^2$ distribution with two degrees of freedom. The null hypothesis $h_0$: is that the residuals are normally distributed. The alternative hypothesis $h_1$: is that the residuals are not normally distributed. The decision rule is: if the test statistic < critical value; then we fail to reject $h_0$. Otherwise $h_0$ is rejected. A drawback of the test is that the critical value is asymptotic meaning the test only holds in large samples. Thankfully we have a relatively large sample comprising more than 100 observations.

Table 3.1 panel A outlines the descriptive statistics of the variables taken from the Barclays equity-gilt study. We find that none of the variables are found to follow the normal distribution. This appears to be primarily due to there being high levels of excess kurtosis present in almost all the series. While this is a concern, it is not uncommon for excess kurtosis to be found in financial data series. Returns series are renowned for being leptokurtic, that is having a greater number of extreme observations (or much fatter tails) than you would find compared to a normal distribution. A more fundamental problem might be that there has been structural breaks in the series considered that will be identified in section 3.5. Perhaps, within each period during which there is no structural change more favourable results would be found.

Table 3.2 panel B provides a correlation matrix for major variables used in the empirical analysis. As one would expect dividend growth ($GD_t$) and dividend model measures of equity return ($RD_t$) and equity premium ($RXD_t$) are extremely highly correlated. Similarly capital gains ($GP_t$) and historical average measures of equity return ($R_t$) and equity premium ($RX_t$) are also extremely highly correlated. However, perhaps surprisingly the contemporaneous correlation between historical average equity premium ($RX_t$) and dividend model equity premium ($RXD_t$) is close to zero. This suggests that in the short run there is little relationship between the measures; our subsequent analysis examines the long run relationship between these measures and finds they are positively associated. It is also worth noting the strong negative correlation between inflation and the risk-free rate, suggesting a rise in inflation leads to low real bond yields. In general, there are a number of moderately high correlations between variables. Perhaps the most notable of these is that between the dividend yield ($D_t/P_{t-1}$) and historical average measures of the equity return ($R_t$) and equity premium ($RX_t$). These correlation results suggest that in econometric analysis then multicollinearity could perhaps be an issue.

## TABLE 3.1: DESCRIPTIVE STATISTICS AND CORRELATIONS

Panel A: Descriptive Statistics

| Variable | No. of Periods | Mean | Standard Deviation | Skewness | Excess Kurtosis | Min. | Max. | JB-stat | P-level | Normally Distributed |
|---|---|---|---|---|---|---|---|---|---|---|
| $Inf_t$ | 102 | 4.21% | 6.93% | 0.09 | 3.70 | -26.00% | 24.89% | 41.52 | [0.00]** | No |
| $F_t$ | 102 | 1.18% | 6.51% | 1.25 | 9.95 | -16.66% | 38.65% | 79.50 | [0.00]** | No |
| $GD_t$ | 102 | 0.98% | 16.04% | 1.50 | 10.23 | -48.69% | 89.83% | 62.37 | [0.00]** | No |
| $GP_t$ | 102 | 2.25% | 19.71% | 0.61 | 3.33 | -62.48% | 89.21% | 26.78 | [0.00]** | No |
| $D_t / P_{t-1}$ | 102 | 4.62% | 1.20% | 1.15 | 4.94 | 1.97% | 10.41% | 27.11 | [0.00]** | No |
| $D_t / P_t$ | 102 | 4.42% | 1.14% | 1.35 | 5.94 | 1.96% | 9.82% | 29.12 | [0.00]** | No |
| $RD_t$ | 102 | 5.60% | 16.33% | 1.30 | 9.48 | -46.58% | 93.63% | 68.59 | [0.00]** | No |
| $R_t$ | 102 | 6.87% | 20.37% | 0.72 | 3.69 | -58.09% | 99.61% | 27.90 | [0.00]** | No |
| $RXD_t$ | 102 | 4.41% | 17.28% | 1.63 | 8.64 | -49.58% | 89.51% | 38.90 | [0.00]** | No |
| $RX_t$ | 102 | 5.68% | 20.92% | 0.86 | 4.78 | -59.88% | 106.65% | 36.03 | [0.00]** | No |

Panel B: Correlation Matrix

| Variable | $Inf_t$ | $F_t$ | $GD_t$ | $GP_t$ | $D_t / P_{t-1}$ | $D_t / P_t$ | $RD_t$ | $R_t$ | $RXD_t$ | $RX_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $Inf_t$ | 1.0000 | | | | | | | | | |
| $F_t$ | -0.8313 | 1.0000 | | | | | | | | |
| $GD_t$ | -0.0647 | 0.1577 | 1.0000 | | | | | | | |
| $GP_t$ | -0.2414 | 0.2770 | 0.0009 | 1.0000 | | | | | | |
| $D_t / P_{t-1}$ | -0.0378 | 0.2308 | 0.2016 | 0.5328 | 1.0000 | | | | | |
| $D_t / P_t$ | -0.0912 | 0.2506 | 0.2487 | -0.2698 | 0.5946 | 1.0000 | | | | |
| $RD_t$ | -0.0860 | 0.1719 | 0.9974 | 0.0400 | 0.2716 | 0.2881 | 1.0000 | | | |
| $R_t$ | -0.2357 | 0.2816 | 0.0127 | 0.9988 | 0.5743 | -0.2259 | 0.0547 | 1.0000 | | |
| $RXD_t$ | 0.2494 | -0.2325 | 0.9213 | -0.0719 | 0.1753 | 0.9182 | 0.9182 | -0.0015 | 1.0000 | |
| $RX_t$ | 0.0372 | -0.0468 | -0.0404 | 0.9456 | 0.5194 | -0.3204 | -0.0015 | 0.9453 | 0.0174 | 1.0000 |

### 3.2.5 STATIONARITY TESTS

Stationarity, in so much as the relevant valuation ratios having a constant mean is a central issue for our dividend growth model, as outlined in Section 3.1. These models rely upon the ratio of the dividends to price having a constant mean in order for dividend growth to give accurate estimates of the capital gain of the share index. If the relevant valuation ratios tend to be characterized as random walk processes then estimates of dividend growth calculated using the Fama-French methodology could give poor approximations of actual share price growth, unless this non-stationarity is caused by rational price adjustment. This controversial issue of rational price adjustment versus systematic mis-pricing can be avoided if the valuation ratios are found to be stationary.

More generally, stationarity is an important issue since it is a pre-requisite for OLS regression analysis to be reliably conducted. If the stationarity conditions[13] are violated then econometric analysis runs a considerable risk of yielding spurious results as illustrated by Granger and Newbold (1974). With the consequences of a non-stationary data series being so dire and potentially disastrous for regression analysis there has been a preference in the literature for diagnostic statistics which test the null hypothesis that the data follows a random walk. This stems from the statistical rejection of the random-walk hypothesis giving a much stronger indication that the data is stationary than an acceptance of a null hypothesis of stationarity.

Stationarity tests based upon the null hypothesis of a random walk were pioneered by Dickey and Fuller (1979). The Dickey-Fuller and Augmented Dickey-

[13] There are 3 conditions of (weak) stationarity, a) constant mean over time, b) constant variance over time and c) constant covariances over time.

Fuller test assesses if the series $Y_t$ follows the null hypothesis of a random walk or the alternative hypothesis that it has a constant mean. The Dickey Fuller test is based upon the following equations:

$$\begin{aligned} & Y_t = \mu_1 + \rho Y_{t-1} + \varepsilon_t \qquad\qquad \varepsilon_t \sim IID(0,\sigma^2) \\ & Y_t - Y_{t-1} = \mu_2 + (\rho - 1)Y_{t-1} + \varepsilon_t \\ & \Delta Y_t = \mu_2 + (\rho - 1)Y_{t-1} + \varepsilon_t \end{aligned} \tag{11}$$

The null hypothesis of the Dickey Fuller test is: ho: p=1. In this case the change in $Y_t$ is determined purely by the white noise error term $\varepsilon_t$. This means that the time series follows a random walk and thus the series is non-stationary. The alternative hypothesis of stationarity is: ho: p<1. If p<1 then the series will have a constant mean. The test statistic follows the tau distribution. The decision rule is if |test statistic| < |critical value| then we fail to reject ho and we infer that the series is a random walk and thus is non-stationary. We reject ho if |test statistic| > |critical value|, which indicates that the series is stationary and does have a constant mean.

If $Y_t$ follows an AR model of order greater than 1 then this would induce serial correlation into the error term of the regression equation causing the error term to no longer be white noise. In order to correct the error term for autocorrelation the augmented dickey fuller (ADF) test can be used, which includes higher order lags into the regression equation.

$$\Delta Y_t = \mu + \omega^* Y_{t-1} + \sum_{p=1}^{P} \omega_p \Delta Y_{t-p} + \varepsilon_t \tag{12}$$

The order of the ADF test is given by the number of lags (P). So, if for example we believed $Y_t$ to follow an AR(3) process we would examine a 3rd order ADF test in which P is set equal to 3. For stationarity we need to examine the term in this equation $\omega^{*}Y_{t-1}$. If the coefficient $\omega^{*} = 0$ then $Y_t$ follows a random walk process and will be non-stationary. However, if $\omega^{*} < 0$ then $Y_t$ it will be a stationary mean-reverting series.

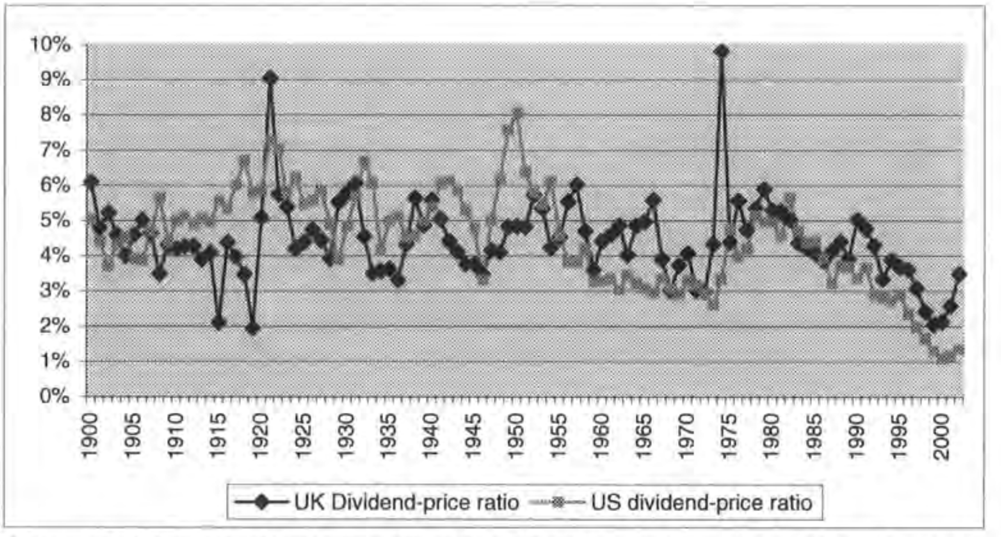
Since we have an annual data series we have no clear theoretical reason to expect any particular lag length for autocorrelation[14]. Consequently, the exact number of lags included is determined according to the minimum AIC model selection criteria, which allows the data to indicate the most appropriate lag length to correct for autocorrelation. Using the ADF test statistics for the appropriate model, we then assess if the series is stationary or not by comparing the test statistic with the critical value drawn from the tau distribution. Table 3.2 reports the results of the ADF tests. We find that all the variables are stationary including those required for econometric analysis in Chapter 3.4 and thus they can be reliably used.

**TABLE 3.2: UNIT ROOT TESTS (1901-2002)**

| Variable | Lags selected by AIC | Test | Test Statistic | Critical Value | Decision | Inference |
|---|---|---|---|---|---|---|
| $D_t / P_t$ | 0 | DF | -6.27 | -2.89 | Reject ho | Series is stationary |
| DPDUM | 0 | DF | -4.46 | -3.45 | Reject ho | Series is stationary |
| $GD_t$ | 0 | DF | -11.30 | -2.89 | Reject ho | Series is stationary |
| $GD2_t$ | 0 | DF | -6.93 | -2.89 | Reject ho | Series is stationary |
| $GD5_t$ | 0 | DF | -3.96 | -2.89 | Reject ho | Series is stationary |
| $GP_t$ | 1 | ADF(1) | -8.09 | -2.89 | Reject ho | Series is stationary |
| $R_t$ | 1 | ADF(1) | -10.10 | -2.89 | Reject ho | Series is stationary |

[14] Maximal lag length in such tests is commonly set to 12 for monthly data or 4 for quarterly data so that any seasonality in the data can be accounted for. In annual data there is no obvious lag length.

**FIGURE 3.1: The UK and the US Dividend-price ratio: 1900-2002**




Notes: UK data is from Barclays equity-gilt study, US data is from Robert Shiller's website.

The finding of stationarity in the case of the dividend-price ratio is especially crucial since this suggests that dividends and prices are in a stable long-term relationship. Thus dividend growth is an appropriate proxy for the capital gains of share prices, providing evidence that the use of the Fama-French dividend growth model (given by (3)) to estimate returns is supported by the data.

Whilst, the dividend-price ratio is stationary for our full sample, this does cover a period of more than 100 years during which there has been substantial changes to the economic environment within which firms operate it. Thus it would be expedient to examine the stationarity of the dividend-price ratio within sub-periods of our overall sample. In order to achieve this, we utilise a rolling unit root procedure as first suggested by Banerjee, Lumsdaine and Stock (1992). Their approach involves running a stationarity test regression over a set sample window and then moving the sample window forward by one period and re-running the stationarity test. We chose the standard Dickey-Fuller test (see equation 11), which for the full sample period was deemed the most suitable specification by the AIC criterion. A 40-year sample window is used which provides enough observations to conduct a stationarity test. Thus our first sample window sets t = 1901-1940 and conducts the Dickey Fuller test over this 40 year period. The sample window then moves forward to cover t = 1902-1941 and so on running 63 separate unit root tests culminating with the 1963-2002 period.

## FIGURE 3.2: DICKEY FULLER TEST STATISTICS

Figure 3.2A: Rolling 40 year Dickey Fuller Tests on the UK Dividend-Price Ratio

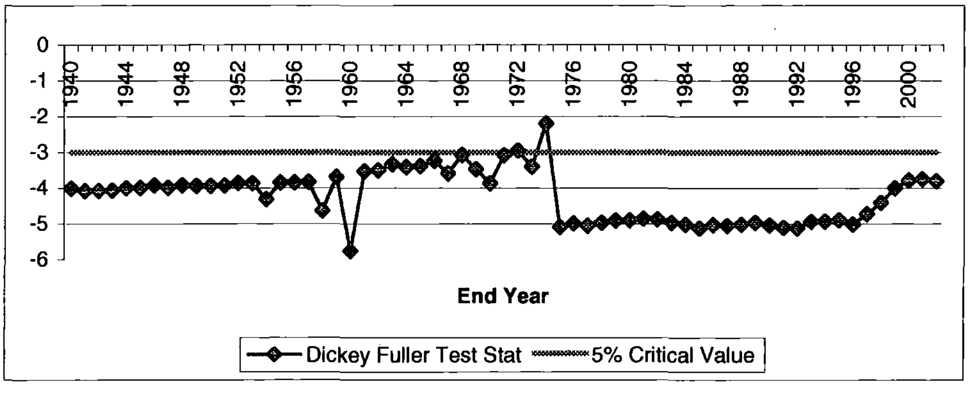
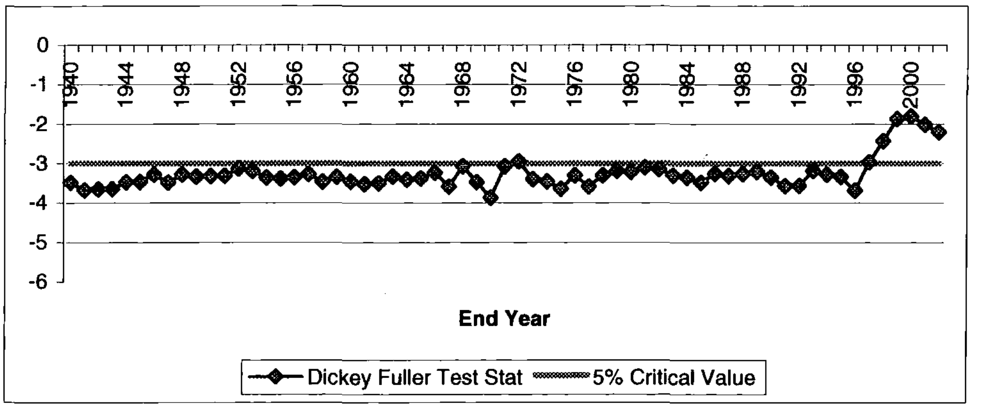



Figure 3.2B: Rolling 40 year Dickey Fuller Tests on Series DPDUM, the UK Dividend-Price Ratio adjusted by use of dummy variables to account for outlying observations in the series




The unit root test statistic values and critical values are plotted through time in figure 3.2. In general we find that the series still exhibits stationarity during almost all sample periods. For any 40 year sample period, except that ending in 1974, the Dickey Fuller test always rejects the null hypothesis of a random walk at the 5%

significance level. The rolling unit-root tests provide broad support for the dividend-price ratio being stationary, as indicated by the test of the whole sample.

A difficulty with unit root tests, particularly the Dickey-Fuller test is that if there are outlying observations that quickly mean-revert then this can inflate the test statistic leading to impression that there is stationarity, when for much of the sample there is little mean reversion. To establish the robustness of the tests to outliers, we remove the impact of the mean reversion caused by these outliers.

In the early part of the sample the dividend-price ratio appears to be exceptionally low in 1915 and 1919 and extremely high during 1921, this period corresponds to World War 1 and its immediate aftermath. In the 1970s there is a large outlying observation in 1974, due to the 1st OPEC oil crisis and the subsequent UK market crash. We therefore include dummy variables for the years 1915, 1919, 1921 and 1974 during which exceptional dividend-price ratios were recorded. We run the regression in equation 13 of the dividend-price ratio on a constant, four dummy variables (where 1915D 1919D, 1921D and 1975D are dummy variables) and a random error term. For example 1915D corresponds to a dummy variable that is 1 in 1915 and 0 in all other years.

$$\begin{aligned} D_t / P_t &= \alpha + \beta_1.(1915D) + \beta_2.(1919D) + \beta_3.(1921D) + \beta_4.(1974D) + \varepsilon_t \\ DPDUM &= D_t / P_t - \beta_1.(1915D) - \beta_2.(1919D) - \beta_3.(1921D) - \beta_4.(1974D) \end{aligned} \quad (13)$$

We then calculated the dividend-price ratio series allowing for dummies (DPDUM), which adjusts the values for the outlying years. Using the DPDUM series with the effects of the outlying observations removed we proceeded to undertake the rolling unit root tests in the same manner as previously described and illustrated in figure 3.2B. With the outlying observations controlled for there doesn't appear to be much of an impact upon the rolling Dickey-Fuller test, except for at the end of the sample. The pre-1990 data provides support for the data being non-stationarity in all sub-periods.

However, the main difference in the stationarity test results are for periods ending after 1997. Before controlling for the 1974 dividend-price observation we found the data clearly rejected the null at the 5% significance level. However, when the effects of this outlier is controlled for we find evidence that samples ending in 1998 or later are deemed to be non-stationary at both the 5% or the 10% significance level. Thus, the very end of the sample appears to exhibit some behaviour consistent with a random walk. This has perhaps been brought about by the gradual transition of the dividend-price ratio to a new mean in the late 1990s, an issue investigated in Chapter 3.4.4.

Overall, apart from perhaps the post-1997 data, we find strong evidence that the dividend-price ratio is stationary as implied by theory. Given dividends and prices appear to be in a stable long-term relationship, this implies that dividend growth will be a good approximation for capital gains and provides confirmation that the Fama-French dividend growth model derived in (3) can be justifiably applied to our dataset.

## 3.3 ANNUAL EQUITY RETURNS

### 3.3.1 EMPIRICAL EVIDENCE FROM THE UK MARKET

Perhaps the most striking feature of our results is that the UK Equity Premium from the overall UK market 1951-2002 based on average realised returns was 7.79%, which is more than 65% larger than the estimate of 4.60% from the Dividend Growth model. Over the period 1901-1950, the dividend growth model estimate of the annual UK equity premium of 4.22%, was similar to the 3.49% premium given by the average returns model. Thus both fundamentals and historical returns indicate that the expected equity premium from the turn of the twentieth century to 1950 was about 4% per annum.

## TABLE 3.3: UK and US ESTIMATES OF EQUITY PREMIA

**Panel A: UK Market Estimates of Equity Premia and Related Statistics**

| UK Data | Variable | $Inf_t$ | $F_t$ | $D_t / P_{t-1}$ | $GD_t$ | $GP_t$ | $RD_t$ | $R_t$ | $RXD_t$ | $RX_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1901-2002 | Mean | 4.21 | 1.18 | 4.62 | 0.98 | 2.25 | 5.60 | 6.87 | 4.41 | 5.68 |
| | St. Dev | 6.96 | 6.54 | 1.21 | 16.12 | 19.80 | 16.41 | 20.47 | 17.37 | 21.02 |
| 1901-1950 | Mean | 2.20 | 0.82 | 4.48 | 0.56 | -0.17 | 5.03 | 4.31 | 4.22 | 3.49 |
| | St. Dev | 8.07 | 8.49 | 0.98 | 22.00 | 14.43 | 22.34 | 14.93 | 23.70 | 15.27 |
| 1951-2002 | Mean | 6.14 | 1.53 | 4.75 | 1.39 | 4.57 | 6.14 | 9.33 | 4.60 | 7.79 |
| | St. Dev | 5.06 | 3.89 | 1.39 | 7.04 | 23.77 | 7.28 | 24.56 | 7.59 | 25.34 |
| 1966-2002 | Mean | 6.97 | 2.09 | 4.60 | 0.49 | 4.28 | 5.09 | 8.88 | 3.00 | 6.79 |
| | St. Dev | 5.44 | 3.95 | 1.54 | 6.82 | 24.69 | 7.04 | 25.57 | 7.20 | 26.56 |

**Panel B: US Market Estimates of Equity Premia and Related Statistics**

| US Data | Variable | $Inf_t$ | $F_t$ | $D_t / P_{t-1}$ | $GD_t$ | $GP_t$ | $RD_t$ | $R_t$ | $RXD_t$ | $RX_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1872-2000 | Mean | 2.16 | 3.24 | 4.70 | 2.08 | 4.11 | 6.78 | 8.81 | 3.54 | 5.57 |
| | St. Dev | 7.51 | 8.48 | 1.39 | 12.37 | 17.83 | 12.56 | 18.03 | 13.00 | 18.51 |
| 1872-1950 | Mean | 0.99 | 3.90 | 5.34 | 2.74 | 2.96 | 8.07 | 8.30 | 4.17 | 4.40 |
| | St. Dev | 9.11 | 10.63 | 1.12 | 15.28 | 18.48 | 15.41 | 18.72 | 16.02 | 19.57 |
| 1951-2000 | Mean | 4.00 | 2.19 | 3.70 | 1.05 | 5.92 | 4.74 | 9.62 | 2.55 | 7.43 |
| | St. Dev | 3.11 | 2.46 | 1.17 | 5.09 | 16.77 | 5.21 | 17.03 | 5.62 | 16.73 |

Notes:
All values reported are annual percentages. Panel A covers UK Data from the Barclays Equity-Gilt Study. Panel B covers US Data reported in Fama & French (2002). $Inf_t$ is the rate of inflation for year t, $(CPI_t / CPI_{t-1}) - 1$. $F_t$ is the real return on Treasury Bills. $d_t$ and $p_t$ are nominal dividends and prices at time t. $D_t / P_{t-1}$ is the real dividend yield, defined as: $(d_t / p_{t-1})*(CPI_{t-1} / CPI_t)$. $GD_t$ is the real growth of dividends for t, $(d_t / d_{t-1})*(CPI_{t-1} / CPI_t) - 1$. $GP_t$ is the real capital gain for t, $(p_t / p_{t-1})*(CPI_{t-1} / CPI_t)$. $RD_t$ is the dividend growth model estimate of equity returns for t, $(D_t / P_{t-1}) + GD_t$. $RXD_t$ is the dividend growth model estimate of the equity premium for t, $RD_t - F_t$. $R_t$ is the realised return at time t, $(D_t / P_{t-1}) + GP_t$. $RX_t$ is the realised equity premium at time t, $R_t - F_t$.

Our results indicate that the dividend growth estimate of the equity premium has been relatively stable, being 4.22% p.a. in the first half of the $20^{th}$ Century compared with 4.60% p.a. since 1951. While, in contrast, the equity premium from average returns has increased substantially from 3.49% pre-1950 to 7.79% post-1950. Thus, the gap between the dividend growth model estimate and the average return estimate has widened substantially.

These two main findings that a) both models yield similar estimates of the equity premium for the pre-1950 era and b) the equity premium from average returns increased substantially in the second half of the $20^{th}$ Century are entirely consistent with the Fama and French (2002) study of S&P 500 firms. Fama and French found the equity premium estimates for 1872-1950 are almost identical being 4.40% for the average return model and 4.17% dividend growth model. These figures are both around the 4% p.a. level found in this study. They also found the average return model estimate rose dramatically to 7.43% for the post 1951 sample from 4.40% for the earlier period, which mirror our results.

However, in one aspect our results are different to Fama and French's. In the US the dividend growth model of the equity premium declined substantially in the second half of the $20^{th}$ century to 2.55% from 4.17% for their earlier sample. In contrast, we find that this figure remains almost unchanged in the UK being 4.22% for 1901-1950 increasing modestly to 4.60% during 1951-2002. Why are there these differences? Perhaps, this is due to changes in American corporations' payout policy which has not been fully mirrored in the UK. Fama and French (2001) demonstrate that the proportion of US firms that pay dividends at all declined substantially in the 1980s and 1990s, whilst Grullon and Michaely (2002) provided evidence that share repurchases have become an important means of distributing funds to shareholders besides dividends. Both these factors could cause US dividend model estimates to be biased downwards. However, in the UK there is little evidence to suggest changes in payout policy have occurred on the same scale as witnessed in the US. Ap Gwilym, Seaton and Thomas (2004) provide evidence that the UK payout ratio was 52.1% in December 2001, their sample end date, which was actually marginally above the average payout ratio of 51.4% for their full sample 1962-2001. Furthermore, share repurchases by British firms have been a far less popular and important mechanism for distributing resources to stockholders in comparison to the US; firstly share repurchases were illegal until the mid-1980s and even since then Rau and Vermaelen (2002) found share repurchase activity in the UK comprised only a very small proportion of total payout until the late 1990s. Dimson and Marsh (2001, p23) comment, "Until the late 1990s (UK) share buybacks were negligible." However, the trends which began in the US during the 1970s appear to become apparent in the UK from the late 1990s onwards. Young and Oswald (2004) find that UK share repurchases become a substantive part of total dividend payout during the late 1990s and Benito and Young (2001) provide evidence that dividend omissions rose in the UK during the late 1990s. Nevertheless there appears to have been little change in the payout policy of British firms until the very end of the sample period. Thus, we suggest that any change in payout policy there may have been will have anything other than a slight influence upon our UK dividend growth model results, which are based on long-run averages.

An important advantage of the UK dividend growth model is that it does provide a more precise estimate of the equity premium since the variance of the dividend model is considerably smaller than that generated by average returns especially since 1950. Furthermore fundamentals are less affected by structural shifts in the economic environment than asset prices themselves. Hence, we contend that the implied equity premia derived from these models provide us with better estimates of expected returns than average historical returns. If this is the case then our results suggest that the equity premium puzzle is considerably smaller than generally cited in financial literature. Average historical returns indicate equities have delivered a premium over treasury bills of approaching 8% p.a. since World War 2, however, the dividend growth model intimates the true expected equity premium is closer to 4.5% p.a.

Could investors in 1950 really have anticipated that stocks would outperform treasury bills by 8% p.a. for the rest of the century? Would they then decide that the risks involved with stocks were too great? If not, then a good deal of stock returns are simply due to good luck, that is they were unexpected. This is an issue we explore in more detail in Chapter 3.4.

We will now examine the equity premium estimates by breaking our model into their constituent parts. The average real Treasury-bill rate rose considerably from 0.82% during 1901-1950 to 1.53% for the post 1950 period. The rising return on the risk-free rate is informative because it has interesting implication for the overall real return on equity given by our models during the different sample periods. The dividend growth model estimate of the average return on equity ($RD_t$) is remarkably steady being around 5 or 6% in all sub-sample periods. In contrast, the average return model gives very different equity return estimates ($R_t$). For 1901-1950 it is 4.31%, similar to that given by the dividend growth model, however since 1951 it rose spectacularly to 9.33%.

The very high average returns received since 1951 has been due to a dramatic rise in the rate of capital gain ($GP_t$). The average annual rate of capital gain increased from -0.17% between 1901 and 1950 to 4.57% for the post 1951 period. Dividend Growth ($GD_t$) rates also increased from 0.56% to 1.39% for 1951-2002. These results suggest that either price growth ($GP_t$) was very low pre-1950 or has been extremely rapid since 1951 or a combination of the two.

The key question is could investors in 1950 have rationally anticipated such high average equity returns of approaching 9% or expected capital gains to be more than 4% p.a.? We suggest that the primary force behind the divergence between our models equity premia estimates seen since 1950 is an unexpectedly high rate of capital gains. This issue is examined in more detail in Chapter 3.4.

### 3.3.2 UK EMPIRICAL EVIDENCE FROM 10 YEAR SUB-SAMPLES

**TABLE 3.4: UK EQUITY PREMIA BY DECADE**

| Sample Period | $Inf_t$ | $F_t$ | $GD_t$ | $GP_t$ | $D_t / P_{t-1}$ | $RD_t$ | $R_t$ | $RXD_t$ | $RX_t$ |
|---|---|---|---|---|---|---|---|---|---|
| 1901-2002 | 4.21% | 1.18% | 0.98% | 2.25% | 4.62% | 5.60% | 6.87% | 4.41% | 5.68% |
| 1901-1910 | 1.00% | 1.63% | -2.68% | -0.28% | 4.50% | 1.82% | 4.22% | 0.19% | 2.59% |
| 1911-1920 | 10.58% | -4.25% | -0.77% | -10.71% | 3.62% | 2.84% | -7.09% | 7.09% | -2.84% |
| 1921-1930 | -5.00% | 7.67% | 6.85% | 8.37% | 5.38% | 12.22% | 13.75% | 4.55% | 6.07% |
| 1931-1940 | 2.47% | 0.91% | -0.33% | -0.61% | 4.45% | 4.12% | 3.84% | 3.22% | 2.93% |
| 1941-1950 | 1.94% | -1.87% | -0.27% | 2.38% | 4.43% | 4.16% | 6.81% | 6.03% | 8.68% |
| 1951-1960 | 4.06% | -0.67% | 5.78% | 9.01% | 5.42% | 11.20% | 14.42% | 11.87% | 15.09% |
| 1961-1970 | 4.28% | 2.15% | -1.29% | 0.17% | 4.48% | 3.18% | 4.65% | 1.03% | 2.50% |
| 1971-1980 | 13.92% | -2.37% | -1.88% | 2.71% | 5.58% | 3.70% | 8.29% | 6.06% | 10.66% |
| 1981-1990 | 6.43% | 4.71% | 5.70% | 7.51% | 5.03% | 10.73% | 12.53% | 6.01% | 7.82% |
| 1991-2002 | 2.68% | 3.46% | -0.92% | 3.65% | 3.51% | 2.60% | 7.16% | -0.86% | 3.70% |

Table 3.4 provides a breakdown of each variable over a 10 year period. Interestingly there seem to be 3 decades of exceptional growth in UK fundamentals: the 1920s, 1950s and 1980s. During each of these decades real dividend growth was above 5% p.a., which is huge considering in other 10-year periods the growth rate

tended to hover close to zero or was even slightly negative in real terms. Since dividend growth was high in the 20s, 50s and 80s and dividend yields were fairly stable the dividend model equity return (the sum of these two variables) was also at its peak in the 20s, 50s and 80s. We also find that UK capital gains hit historical highs during the 20s, 50s and 80s as did UK average equity returns (the sum of average capital gain and average dividend yield) at the same times as fundamentals were growing strongly.

A seemingly compelling explanation is that during these periods dividends grew strongly and were expected to continue to grow at above average rates, thus investors raised their valuations of the average stock stimulating high capital gains. However, the causality from fundamental performance to stock return cannot be established unequivocally at least initially. It is plausible that some other factor perhaps economic news caused stock prices to rise, forcing corporate mangers wishing to appease investors demanding a reasonable yield to increase dividend payments. This second hypothesis, however, appears not to be supported by the data in table 3.4. Both the dividend-price ratio and dividend yield were well above their means during the 20s, 50s and 80s, rather than struggling to keep pace with the historical average as would be expected if the causality flowed from prices to dividends. It seems more likely thus that the high level of dividend growth stimulated the rapid capital gains during these periods.

As mentioned above the dividend yield and dividend-price ratio tended to only fluctuate within quite narrow bounds with highpoints during the 1920s, 50s, 70s and 80s. However, the high levels during the 1970s appear to have been driven by the outlier in 1974, which occurred at the time of the stock market crash following the 1$^{st}$ OPEC oil crisis. The ratios were exceptionally low during the 1910's, mainly due to two outliers during World War 1, and the 1990s especially from the mid-1990s onwards during which the ratios fell and remained considerably below there long run average. In Chapter 3.4.4 we examine if in fact this fall constitutes a structural change in the dividend-price process.

Our inflation indicator fluctuates quite widely across the different decades. It was extremely high during the 1910's and during the 1970s. The high inflation of the 1970s in large part stimulated by the OPEC oil crises and the inflationary effects upon the economy have been well documented in the economic literature. Outside of these two spurts of rapid inflation there has been a much more steady appreciation of the price index, often around 3-4% p.a., the one notable exception being the 1920s when our data suggests there was deflation.

Our results suggest there is a negative relationship between the inflation rate and the real risk-free rate. When inflation was high during the 1910's and 1970s the real risk-free rate was negative, but when there was deflation in the 1920s the real risk-free rate was at its highest level for the entire 20$^{th}$ century. Furthermore, the real risk-free rate appears exhibit some modest volatility over time, when it is usually surmised to be relatively constant. This appears to support the view that unanticipated inflation does impact upon the risk-free rate and thus the equity premium.

While we have noted in this section that equity returns were at their highest when dividend growth was also high during the 1950s and 1980s, this doesn't provide a satisfactory answer to why since 1951 has historical returns exceeded the dividend growth model return by so much. For example, during the 1970s and 1990s real dividend growth was negative but real capital gains were still around 3% p.a. In Chapter 3.4 we tackle the question of what has caused our two estimates of equity returns to differ by so much during the second half of the 20$^{th}$ Century.

## 3.4 EXPLAINING UK EQUITY RETURNS

### 3.4.1 WHAT HAS CAUSED THE REALISED RETURN TO EXCEED THE RETURN IMPLIED BY FUNDAMENTALS BY SO MUCH?

If the models hold then the divergence in actual returns away from their fundamentals must be due to capital gains that were unanticipated at the beginning of the sample period.

Valuation theory, states that this can be caused by either:

A) the expected future growth of fundamentals being unusually high.

B) faster growth of fundamentals than expected during the sample period.

C) a decline in expected unconditional stock returns during the sample period.

### 3.4.2 ARE POST 2000 EXPECTED DIVIDEND GROWTH RATES UNUSUALLY HIGH?

It has been argued that we have entered a new economic era, which has enabled higher rates of economic growth to be attained. One claim is that the ever increasing pace of technological developments has facilitated more rapid productivity growth (Jagannathan et al, 2001). An alternative argument is that increasing globalisation as witnessed by growing moves towards a truly globally integrated economic system in which resources can be allocated more efficiently due to previous barriers being removed and in which companies are able to locate production internationally in order to minimise costs. A final assertion is that substantial declines in inflation during the latter part of the 20th Century in many developed economies has set the footing for higher economic growth in the future,[15] economic policymakers have argued. Policymakers assert that lower and less volatile inflation rates (witnessed in recent years) provide businesses and entrepreneurs with a more stable economic environment in which long term investments can be undertaken with more confidence providing a basis for continuing rapid growth in GDP underpinned by higher earnings growth rates which would feed dividend increases. These three factors: a) technological improvements, b) globalisation and c) declining inflation - have lead to hopes that higher levels of economic growth can be achieved and sustained long into the future.

However, if these higher future expected growth rates had not been anticipated at the beginning of our sample period then this would lead to unexpected capital gains being realised by investors as the potential for extended periods of high economic growth became known to investors and incorporated into their expectations. A critic of this view would point out that dividend growth has been fairly low since the 1960s and especially since 1991 (see table 3.4). Thus, it would be difficult to believe that investors would expect dividend growth to be unusually high in the future.

This is however an issue which we can test empirically. We can examine the in-sample predictability of dividend growth. Using the results from these regressions we can then examine if there is a robust relationship between the predictor variables and dividend growth. From these regressions future dividend growth can be forecast.

[15] However, Modigliani and Cohn (1979) argue that inflation causes money illusion amongst investors who discount cashflows using too low a discount rate during periods of high inflation and vice-versa; if this is true investors act irrationally. Ritter and Warr (2002) provide some empirical support for this hypothesis.

### 3.4.2.1 IN-SAMPLE PREDICTABILITY OF DIVIDEND GROWTH USING ALL POSSIBLE CANDIDATE VARIABLES

We examine the predictability of the dividend growth rate from variables known in advance in a similar manner to Fama-French (2002). We analyse the predictability of fundamental growth rates using 2 methods. Firstly, we select variables that have been documented to predict returns and examine if they have any explanatory power over dividend growth. Secondly, we identify variables that appear to have predictive ability such as the dividend-price ratio and model these relationships parsimoniously.

The candidate variables which are available for our whole sample are: i) the lagged dividend-price ratio $(D_{t-1}/P_{t-1})$, ii) prior dividend growth rates $(GD_{t-1})$, 2) prior returns $(R_{t-1})$ and iv) the short-term interest rate $(F_{t-1})$. These have all been documented in the literature to have explanatory power over future returns. Here we assess if they are able to predict future growth rates of dividends. The estimated regression is given by equation 14. Other variables used in this study could also have been included such as inflation, however we exclude inflation since the correlation matrix (Table 3.1 Panel A) demonstrates it is highly correlated with the short-term interest rate. Including inflation could thus amplify the effects of any multicollinearity in the regression. Since the real risk-free rate has been used in prior studies (such as Ang (2002)) we adopt it here.

$$\begin{aligned} GD_t &= \alpha + \beta_1.(D_{t-1}/P_{t-1}) + \beta_2.GD_{t-1} + \beta_3.GD_{t-2} \\ &+\beta_4.GD_{t-3} + \beta_5.R_{t-1} + \beta_6.R_{t-2} + \beta_7.R_{t-3} + \beta_8.F_{t-1} + \varepsilon_t \end{aligned} \tag{14}$$

# TABLE 3.5: IN-SAMPLE PREDICTABILITY OF REAL DIVIDEND GROWTH

**Panel A: Predicting Dividend Growth with all Potential Predictor Variables**

**Sample Period: Pre-1950**

| Y | Sample | Variable | Constant | $D_{t-1}/P_{t-1}$ | $GD_{t-1}$ | $GD_{t-2}$ | $GD_{t-3}$ | $R_{t-1}$ | $R_{t-2}$ | $R_{t-3}$ | $F_{t-1}$ | $R^2$ | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $GD_t$ | 1904-1950 | Coefficient | 0.14 | -5.22 | -0.17 | -0.12 | -0.31 | 0.17 | 0.24 | 0.07 | 0.03 | 0.28 | 1.81 |
| | | t-value | 0.72 | -1.17 | -0.91 | -0.63 | -1.95 | 0.76 | 1.01 | 0.32 | 1.61 | | [0.105] |
| $GD2_t$ | 1904-1950 | Coefficient | 0.04 | -1.07 | -0.17 | -0.24 | -0.16 | 0.26 | 0.19 | 0.05 | -0.08 | 0.26 | 1.64 |
| | | t-value | 0.27 | -0.33 | -1.29 | -1.74 | -1.31 | 1.69 | 0.87 | 0.36 | -0.20 | | [0.147] |
| $GD5_t$ | 1904-1950 | Coefficient | -0.01 | -0.42 | -0.05 | -0.07 | -0.03 | 0.12 | 0.01 | -0.04 | 0.01 | 0.16 | 0.88 |
| | | t-value | -0.15 | -0.29 | -0.82 | -1.03 | -0.52 | 1.74 | 0.17 | -0.52 | 1.56 | | [0.539] |

**Sample Period: Post-1951**

| Y | Sample | Variable | Constant | $D_{t-1}/P_{t-1}$ | $GD_{t-1}$ | $GD_{t-2}$ | $GD_{t-3}$ | $R_{t-1}$ | $R_{t-2}$ | $R_{t-3}$ | $F_{t-1}$ | $R^2$ | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $GD_t$ | 1951-2002 | Coefficient | -0.04 | 0.97 | 0.19 | 0.04 | -0.10 | 0.13 | 0.07 | 0.01 | 0.00 | 0.28 | 2.13 |
| | | t-value | -0.73 | 0.99 | 1.15 | 0.28 | -0.74 | 2.45 | 1.27 | 0.20 | -0.78 | | [0.053] |
| $GD2_t$ | 1951-2001 | Coefficient | -0.08 | 1.92 | 0.09 | -0.09 | 0.04 | 0.14 | 0.07 | 0.03 | 0.00 | 0.25 | 1.77 |
| | | t-value | -1.70 | 2.08 | 0.60 | -0.68 | 0.35 | 2.84 | 1.41 | 0.68 | -0.81 | | [0.111] |
| $GD5_t$ | 1951-1998 | Coefficient | -0.14 | 2.88 | 0.01 | 0.10 | 0.05 | 0.12 | 0.06 | 0.02 | 0.00 | 0.33 | 2.35 |
| | | t-value | -3.53 | 3.81 | 0.11 | 0.90 | 0.58 | 3.24 | 1.84 | 0.76 | -0.04 | | [0.036]* |

Notes:

The regression intercept is constant and t-value is the regression co-efficient divided by its standard error.

The nominal value of the equity price index and the nominal dividend paid at the end of year t are $d_t$ and $p_t$. The price level at the end of year t is $CPI_t$

The real one year dividend growth rate for year t is $GD_t = (d_t/d_{t-1})*(CPI_{t-1}/CPI_t)-1$.

The real two-year average dividend growth rate is $GD2_t = [(d_{t+1}/d_{t-1})*(CPI_{t-1}/CPI_{t+1})-1]/2$

The real five-year average dividend growth rate is $GD5_t = [(d_{t+4}/d_{t-1})*(CPI_{t-1}/CPI_{t+4})-1]/5$

## TABLE 3.5: IN-SAMPLE PREDICTABILITY OF REAL DIVIDEND GROWTH (CONTINUED)

**Panel B: Predicting Dividend Growth with the Dividend-Price ratio**

**Sample Period: Pre-1950**

| Y | Sample | Variable | Constant | $D_{t-1}/P_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1904-1950 | Coefficient | 0.36 | -7.95 | 0.15 |
| | | t-value | 2.93 | -2.96 | |
| $GD_2$ | 1904-1950 | Coefficient | 0.25 | -5.32 | 0.14 |
| | | t-value | 2.77 | -2.74 | |
| $GD_5$ | 1904-1950 | Coefficient | 0.04 | -0.97 | 0.02 |
| | | t-value | 1.07 | -1.07 | |

**Sample Period: Post-1951**

| Y | Sample | Variable | Constant | $D_{t-1}/P_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1951-2002 | Coefficient | 0.04 | -0.66 | 0.01 |
| | | t-value | 1.15 | -0.81 | |
| $GD_2$ | 1951-2001 | Coefficient | 0.01 | 0.16 | 0.00 |
| | | t-value | 0.24 | 0.23 | |
| $GD_5$ | 1951-1998 | Coefficient | -0.03 | 1.01 | 0.06 |
| | | t-value | -1.10 | 1.78 | |

**Panel C: Predicting Dividend Growth with lagged Dividend Growth**

**Sample Period: Pre-1950**

| Y | Sample | Variable | Constant | $GD_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1904-1950 | Coefficient | 0.02 | -0.18 | 0.03 |
| | | t-value | 0.48 | -1.23 | |
| $GD_2$ | 1904-1950 | Coefficient | 0.01 | -0.14 | 0.04 |
| | | t-value | 0.51 | -1.43 | |
| $GD_5$ | 1904-1950 | Coefficient | 0.00 | -0.04 | 0.02 |
| | | t-value | 0.17 | -0.85 | |

**Sample Period: Post-1951**

| Y | Sample | Variable | Constant | $GD_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1951-2002 | Coefficient | 0.01 | 0.36 | 0.13 |
| | | t-value | 0.939 | 2.69 | |
| $GD_2$ | 1951-2001 | Coefficient | 0.01 | 0.22 | 0.07 |
| | | t-value | 1.43 | 1.87 | |
| $GD_5$ | 1951-1998 | Coefficient | 0.01 | 0.12 | 0.03 |
| | | t-value | 2.22 | 1.24 | |

**Panel D: Predicting Dividend Growth with Returns**

**Sample Period: Pre-1950**

| Y | Sample | Variable | Constant | $R_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1904-1950 | Coefficient | 0.01 | 0.04 | 0.00 |
| | | t-value | 0.36 | 0.17 | |
| $GD_2$ | 1904-1950 | Coefficient | 0.00 | 0.15 | 0.02 |
| | | t-value | 0.15 | 1.01 | |
| $GD_5$ | 1904-1950 | Coefficient | 0.00 | 0.08 | 0.03 |
| | | t-value | -0.21 | 1.23 | |

**Sample Period: Post-1951**

| Y | Sample | Variable | Constant | $R_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| $GD_1$ | 1951-2002 | Coefficient | 0.00 | 0.11 | 0.13 |
| | | t-value | 0.32 | 2.78 | |
| $GD_2$ | 1951-2001 | Coefficient | 0.01 | 0.08 | 0.12 |
| | | t-value | 0.73 | 2.52 | |
| $GD_5$ | 1951-1998 | Coefficient | 0.01 | 0.03 | 0.02 |
| | | t-value | 2.03 | 1.06 | |

We split our dataset into the pre-1950 and post-1951 sub-samples. The rationale behind this is that we are trying to uncover the difference in the behaviour of the equity premium over the first half of the $20^{th}$ century when dividend growth and average returns provided similar equity premium estimates and the second half of the $20^{th}$ century when these methods provided divergent estimates of stock returns.

Panel A of Table 3.5 demonstrates that equation 14 can account for approximately 28% of the variation in one-year dividend growth during both sub-samples. However, the individual coefficients for all variables (except the 1 year lagged return for post 1950) are deemed to be statistically insignificant by the t-test. Similar results with very few individually statistically significant variables are also reported for two-year average dividend growth[16]. We also examine five-year average dividend growth[17]. We find that for the pre-1950 period none of the variables are found to be statistically significant and $R^2$ is only 16%. However, for the post 1950 period the regression is able to explain 33% of the variation in dividend growth. Furthermore both the lagged dividend price ratio and one period lagged return are statistically significant from zero at the 1% significance level. However, the dividend-price ratio has a positive sign contrary to our expectation that dividends should help move the dividend-price ratio towards its mean value. This is discussed in more detail in Section 3.4.2.2.

Nevertheless, given that we generally find there are so few statistically significant independent variables, but $R^2$ is not tiny we suspect that there is multi-collinearity between some of the predictor variables, which has inflated the estimated standard errors of the multi-collinearous variables. The moderate $R^2$ values obtained from the estimated regressions using equation 14 suggests there might be some modest in-sample predictability of the dividend growth rate. However, the pattern of the predictability is difficult to detect because the regressions estimated appear to suffer from multi-collinearity, which deflates the t-test statistics. The correlation matrix (Table 3.1 Panel B) highlights that there are indeed at least moderate correlations between many of the predictor variables. For instance, dividend-price ($D_t/P_t$) ratio is moderately correlated with both the real risk-free rate ($F_t$) and the real

[16] 2 year average dividend growth $GD2_t = \frac{[(D_{t+1} - D_{t-1})/D_{t-1}]}{2}$

[17] 5 year average dividend growth $GD5_t = \frac{[(D_{t+4} - D_{t-1})/D_{t-1}]}{5}$

return ($R_t$). Consequently, in the next section we examine if more parsimonious models can identify which variables, if any, are actually able to predict future dividend growth.

### 3.4.2.2 IN-SAMPLE PREDICTABILITY OF DIVIDEND GROWTH USING PARSIMONIOUS REGRESSIONS.

In this section we consider the in-sample predictability of dividend growth by either the dividend-price ratio or prior dividend growth or prior returns. Our motivation for examining the predictive power of each variable individually is that our results from Chapter 3.4.2.1 aroused suspicion that there is some correlation between these predictor variables. The regression results reported in this section should give us a much clearer picture of the relationship between the relevant independent variable and dividend growth rates, since unlike the regressions estimated in Chapter 3.4.2.1 they will not be affected by multicollinearity. We first consider the dividend-price ratio.

There is a burgeoning literature that has examined the ability of the dividend-price ratio to predict future returns[18], which has generally shown some evidence of return predictability, especially in data prior to the 1990s. In this section we focus on a two-variable regression model, using only the dividend-price ratio to predict dividends. The regressions we estimate is given by equation 15.

[18] Beginning with Fama and French (1987)

$$GD_t = \alpha + \beta.(D_{t-1}/P_{t-1}) + \varepsilon_t$$
$$GD2_t = \alpha + \beta.(D_{t-1}/P_{t-1}) + \varepsilon_t \qquad (15)$$
$$GD5_t = \alpha + \beta.(D_{t-1}/P_{t-1}) + \varepsilon_t$$

In these regressions the coefficient of prime interest is *B*. We expect that $\beta$ should be negative. When dividends are high relative to prices then one would expect dividend growth to be low, so that the dividend-price ratio will revert towards its mean; for this to occur $\beta$ must be negative.

In contrast with the results from Section 3.4.2.1 we do find some statistical evidence of predictability using the dividend price ratio. For 1904-1950 there is a statistically significant negative relationship between the lagged dividend-price ratio and dividend growth at both 1 year and 2 year horizons. What is more this parsimonious model can explain approximately 15% of the variation in dividend growth rates during this period. However, the predictive ability of the dividend-price ratio evaporates at longer horizons. For five-year future dividend growth, the dividend-price ratio becomes statistically insignificant is unable to explain any more than 2% of the subsequent variation in dividend growth between 1904-1950.

Since 1951 the dividend-price ratio appears to have lost any predictive ability over dividend growth; the t-statistics become insignificant at all horizons and the coefficient of determination ($R^2$) tends to zero. However, contrary to our expectations, at the two year and five year horizons the coefficient on the dividend-price ratio is positive, but is insignificant.

In part, the results of this section conflict with those reported in Section 3.4.2.1, where we examined the relationship between dividend growth and all potential predictor variables. Firstly, over the pre-1950 sample our more parsimonious specification of the relationship between the dividend-price ratio and dividend growth

(15) indicated a significantly negative relationship between these variables at the one and two year horizon. Whereas our results from the more general specification (14) failed to detect a statistically important connection. We suggest the failure of (14) to identify this relationship is due to multicollinearity, with the dividend-price ratio, lagged dividend growth and lagged returns capturing much of the same phenomena. If there is multicollinearity in (14) then the estimated standard errors of the coefficients will be overstated and consequently the t-test statistics will be deflated leading to this inference.

A second instance of a disparity in results is that over the post-1951 period regressions of (14) indicated a significant positive relationship between the dividend-price ratio and dividend growth at the two or five year horizon, whereas the more parsimonious specification (15) suggests these variables are insignificantly related. We suspect that this finding is also due to multicollinearity. If there is high correlation between independent variables then this can induce a bias into the OLS estimated coefficient on each independent variable. As in this case, this can lead to a counter-intuitive and spurious results being found.

Since, we find that over the past fifty years the dividend-price ratio and future dividend growth are essentially unrelated, this provides no evidence to suggest that long-term growth rates of fundamentals should be extraordinarily high in the future. Our findings are consistent with Campbell and Shiller's statement (2001, p6), "It is the denominator of the dividend–price ratio that brings the ratio back to its mean, not the numerator." Similarly, we find the numerator of the UK dividend-price ratio has played no role in restoring the ratio to its long-run mean since 1951.

Our results from Section 3.4.2.1 did indicate that perhaps lagged dividend growth might be able to predict dividend growth. We estimate a parsimonious model with just one lag of dividend growth included[19].

$$\begin{aligned} GD_t &= \alpha + \beta.(GD_{t-1}) + \varepsilon_t \\ GD2_t &= \alpha + \beta.(GD_{t-1}) + \varepsilon_t \\ GD5_t &= \alpha + \beta.(GD_{t-1}) + \varepsilon_t \end{aligned} \qquad (16)$$

This specification provides an interesting insight. Table 3.5 Panel C reveals that over 1951-2002, this model performs well at both the 1 year and 2 year horizon. The $\beta$ coefficient was significant and positive, indicating that there is some persistence in the dividend growth rate. This is consistent with the field research of Lintner (1956), who suggested that dividends partially adjust each year towards an optimal level. The model can account for a respectable portion of dividend growth variability for 1951-2002, especially at the one year horizon. Although the five year horizon results indicate that this element of predictability disappears at longer horizons. In contrast, we find no evidence of in-sample predictability over the earlier sample period, 1901-1950. The lagged dividend growth model performs extremely poorly with a tiny $R^2$ and insignificant coefficients on the independent variable. Consequently, the pre-1950 data doesn't support there being any link between lagged dividend growth and future dividend growth.

Another possible candidate for predicting dividend growth is lagged returns, the results from Section 3.4.2.1 indicate. We suggest that economic news about fundamentals received during time period t-1 will be rapidly impounded into the

[19] Higher order specifications were estimated but the coefficients on these lags proved to be insignificant and provide little additional explanatory power, thus the results are not presented here.

return series but will only become visible in the dividend series during time t or possibly time t+1. This we would expect the coefficient on lagged returns to be positive. A high return in time t-1 might be linked with expectations of high dividend growth in the future. Again, a parsimonious model with just one lag of the variable included was utilised[20].

$$\begin{aligned} GD_t &= \alpha + \beta.(R_{t-1}) + \varepsilon_t \\ GD2_t &= \alpha + \beta.(R_{t-1}) + \varepsilon_t \\ GD5_t &= \alpha + \beta.(R_{t-1}) + \varepsilon_t \end{aligned} \tag{17}$$

Similar to the dividend growth specification over 1951-2002 the lagged return performed well at explaining future dividend growth at both the 1-year and 2-year horizons. The $\beta$ coefficient was significant and accounted for a reasonable portion of dividend growth variability at both horizons. However, at the five-year horizon we discover that returns are insignificantly linked with dividend growth. Over the earlier sample period, 1901-1950, we find that lagged returns are scarcely able to explain any variation in dividend growth and the $\beta$ coefficient was not being significantly different from zero.

### 3.4.2.3 IN-SAMPLE PREDICTABILITY: CONCLUSION

Our results indicate that at longer horizons of five-years or more that dividend growth is essentially unpredictable. Individually, neither the lagged dividend-price

[20] Higher order specifications were estimated but the coefficients on these lags proved to be insignificant and provide little additional explanatory power, thus the results are not presented here.

ratio, nor lagged dividends, nor lagged returns are statistically significantly related to future dividend growth at the five-year horizon. In this case it would appear that the historical average rate of dividend growth is likely to be the best predictor of future dividend growth. Since 1951, we know this has averaged 1.39% p.a. which is not exceptionally high and we find no evidence to suggest that future long-term dividend growth is liable to be extraordinarily rapid.

Even at shorter horizons, where we do detect a significant in-sample relationship between dividend growth and lagged dividend growth and lagged returns respectively, these models do not indicate that future dividend growth is anticipated to be high. Dividend growth was below its historical average during the sample end years of 2000, 2001 and 2002, consequently extrapolating into the future using the regression results from (16) would imply future dividend growth was anticipated to be below average. Returns were actually negative in 2000, 2001 and 2002, thus end-of-sample forecasts of short-run future dividend growth from (17) at either the one or two year horizon proves to be negative.

Consequently, our evidence indicates that the outlook for dividend growth in December 2002 can at best be expected to equal the historical average dividend growth rate. However, in the short-term rational agents might anticipate dividend growth to be even below the historical average. Consequently, we find no evidence whatsoever to support the hypothesis that future dividend growth is expected to be exceptionally high. Fama and French (2002 p651) reach a similar conclusion. "In short, we find no evidence to support a forecast of strong future dividend growth at the end of our sample period." Our contention is that since the historical average growth rate of dividends was not extraordinarily high around the turn of the 21$^{st}$ Century, nor were predictions from models based on in-sample predictability unusually high, then lofty expectations of future dividend growth cannot be the cause of the unanticipated capital gains witnessed since 1951 in the UK. Consequently, we suggest that the deviation between expected returns implied by dividend growth and average returns must have been caused by a factor other than the anticipation of extraordinarily rapid dividend growth in the post 2002 period.

### 3.4.3 IS DIVIDEND GROWTH (1951-2002) UNEXPECTEDLY HIGH?

If dividend growth in the second half of the 20$^{th}$ Century had been above expectations formed in 1950 then this would lead to an unanticipated rise in equity prices. However, even if in-sample growth had been extraordinarily large then the expected return estimates from fundamentals would also have been large and prices would have responded to this. Had the dividend-price ratio or earnings-price ratio been the same in 2002 as in 1951 (or 1901) the estimates of all three models would have been equal.

In the UK, we find that dividend growth showed an increase during the latter part of the 20$^{th}$ century. Real dividend growth was 0.56% over the period 1901-1950, increasing to an average rate of 1.39% from 1951-2002. However, the magnitude of the increase is sensitive to the inclusion of 1901 in the pre-1950 sample. Between 1902-1950 the real dividend growth rate was 1.18%, just a modest 0.21% below the rate observed post-1950.

Furthermore, part of the increase in dividend growth is likely to have been expected due to increased economic stability following the end of World War 2. In fact, dividend growth was at its peak in the 1950s and has averaged less than 0.5%

since 1960, which is even less than during the earlier sample period. The 1950s aside rather than being impressively high, dividend growth has shown few signs of extraordinary growth in the latter part of the 20$^{th}$ Century.

Thus we find some support for the hypothesis that dividend growth has been high since the 1950s, although a good deal of this in all likelihood would have been expected. Since 1960, there is much less support for dividend growth having been very high. Even if dividend growth had been high it would not have been able to explain the divergence between the equity premium derived from fundamentals and that from realised returns, since such economic news is rapidly impounded into share prices.

However, this hypothesis can be tested directly and in much more detail by examining the out-of sample forecasting power of variables discovered to be linked with dividend growth from our in-sample tests.

### 3.4.3.1 OUT OF SAMPLE FORECASTING OF DIVIDEND GROWTH

The results obtained in Section 3.4.2 relate to in-sample predictability of dividend growth. In-sample tests are useful for identifying historical relationships between variables. They use all the available data to estimate the coefficients. However, they are of limited use if we are concerned with investors' expectations at a particular point in time. For example, an investor in 1970 does not have access to data on dividend-price and dividend growth for the post 1970 period; this investor only has pre-1970 data at his disposal in which to forecast dividend or earnings growth for 1971. Modifying the testing procedure to take account of this will give us a much clearer indication of exactly what could be expected by an investor at any point in time. Hence out-of-sample tests are much more appropriate to examine forecasting relationships since they only allow forecasts to be made from information available to agents prior to the forecasting period. This will enable us to examine if and when dividend growth exceeded investor expectations during the period 1951-2002.

Out of sample tests will also provide us with the opportunity to test the claims made by Fama and French (2002) that the historical average dividend growth rate is the best predictor of long term future dividend growth. "In sum, the behavior of dividends for 1951 to 2000 suggests that future growth is largely unpredictable, so the historical mean growth rate is a near optimal forecast of future growth." (Fama and French, 2002 p651)

We test if these claims made by Fama and French hold for the UK market by investigating the out-of-sample forecasting power of the average historical dividend growth rate compared to variables which have demonstrated in-sample predictability. The predictor variables we include are the dividend-price ratio, dividend growth and returns, each of which we found to have some predictability over in-sample dividend growth. For completeness, we also compare the results of all these models with the random walk model that naively predicts that any change in the growth rate is unexpected.

### 3.4.3.2 OUT-OF-SAMPLE FORECASTING OF DIVIDEND GROWTH: METHODOLOGY

The historical growth rate model is defined as:

$$E(GD_{t+1}) = \overline{GD_t} \qquad t = 1902,....,t \tag{18}$$

That is next periods expected dividend growth rate is equal to the mean of all previous dividend growth rates. Fama and French (2002) maintain this is the best available forecast.

The naïve or random-walk model is simply:

$$E(GD_{t+1}) = GD_t \tag{19}$$

The expectation of the naïve model is that next periods dividend growth rate is equal to the current dividend growth rate. Thus, any change in the growth rate is unexpected.

The remaining three models rely upon a two-step process in which the time-varying coefficients of the model are firstly estimated and then secondly a forecasting calculation is made. An identical process is followed for each predictor variable denoted by $X_t$ in the derivation that follows, where $X_t$ is either the dividend-price ratio $(D_t / P_t)$, dividend growth rate $(GD_t)$ or return $(R_t)$. Throughout, our analysis is based purely on data available to the investor at time t.

Firstly, the model is estimated up until the current time period. We make use of a rolling regression technique to estimate the coefficients[21]. A rolling window

[21] A recursive estimation procedure was also conducted for the dividend-price ratio. In terms of forecasting, both the recursive and rolling dividend-price methods appear to predict some of the wide fluctuations in aggregate dividend growth rates over time. However, the forecast errors of both models tend to move closely together over time with very similar mean absolute errors and mean squared

approach is utilised so that the number of observations used to estimate the coefficients is held constant.

Co-efficient Estimation Equations:

For One year real dividend growth $GD_t$

$$GD_t = \alpha_t + \beta_t(X_{t-1}) + \varepsilon_t \quad estimated \quad for \quad t = t-19,....,t$$

where $(X_{t-1})$ is $(D_{t-1}/P_{t-1}),(GD_{t-1})$ or $(R_{t-1})$. (20)

For Two year average real dividend growth $GD2_t$

$$GD2_{t-1} = \alpha_t + \beta_t(X_{t-2}) + \varepsilon_t \quad estimated \quad for \quad t = t-19,....,t$$

where $(X_{t-2})$ is $(D_{t-2}/P_{t-2}),(GD_{t-2})$ or $(R_{t-2})$.

Forecasting Equations:

For One year real dividend growth $GD_t$

$$GD_{t+1} = \alpha_t + \beta_t(X_t)$$

where $(X_t)$ is $(D_t/P_t),(GD_t)$ or $(R_t)$ (21)

For Two year average real dividend growth $GD2_t$

$$GD2_{t+1} = \alpha_t + \beta_t(X_t)$$

where $(X_t)$ is $(D_t/P_t),(GD_t)$ or $(R_t)$

We use a window length of twenty years since a sample of at least twenty observations is necessary to enable credible estimations of $\alpha_t$ & $\beta_t$ to be derived. We estimate equation (20) is estimated over a 20 year period from t-19 to the current time period (t). Thus, $\alpha_t$ & $\beta_t$ are updated through time and for each forecast. Our earliest coefficient estimation is for observations of the independent variable ($X_{t-1}$) from 1902-1921 to estimate dividend growth over the period 1903-1922. Our estimates of the

errors for the full sample period 1923-2002. Although the errors were slightly smaller for the rolling model indicating it provides slightly more accurate forecasts.

parameters $\alpha_t$ & $\beta_t$ are combined with the current value of $X_t$, in order to forecast the average future dividend growth rate over the next one or two years using (21). At the one year horizon, therefore the first forecast value for dividend growth is for 1923, while at the two year horizon its 1924. The process is repeated for all T from t=1922 to t=2001, so that 80 forecasts are produced.

#### 3.4.3.3. OUT-OF-SAMPLE FORECASTING OF DIVIDEND GROWTH: TIME-VARIATION IN *B*

Since, we employ a rolling window technique to forecast dividend growth it is natural that the values of $\alpha_t$ & $\beta_t$ will vary over time. In this section we explore how much these parameters vary through time. Our estimation equation (20) reveals that there is in fact substantial time-variation in $\alpha$ & $\beta$. In particular $\beta$ is of special interest since this coefficient determines the response of dividend growth to a change in the independent variable. Figure 3.3 illustrates graphically that there is substantial time-variation in the $\beta$ coefficients from all three models estimated from (20).

$$\begin{aligned} GD_t &= \alpha_t + \beta_t (D_{t-1}/P_{t-1}) + \varepsilon_t \\ GD2_t &= \alpha_t + \beta_t (D_{t-1}/P_{t-1}) + \varepsilon_t \end{aligned} \tag{22}$$

For the dividend-price ratio we expect that $\beta$ should be negative. If the dividend-price ratio is above its mean then future dividend growth should be below average to guide it back to equilibrium. At the one year horizon, we find that $\beta$ on the dividend-price ratio does tend to be negative as predicted by theory. In particular we find that it is most strongly negative during the early part of our sample up until the mid-1950s[22]. However, $\beta$ tends to move towards 0 as the sample period progresses, indicating that the relationship between the lagged dividend-price ratio and dividend growth weakens over the sample period. In fact, the rolling estimates for $\beta$ turns positive in 1999 and remains so until 2002 at both the one year and two year horizon, contrary to theory. At the two-year horizon we also find that $\beta$ is positive throughout the 1960s.

## FIGURE 3.3: TIME-VARIATION IN REGRESSION COEFFICIENTS

Figure 3A: Forecasting 1 Year Dividend Growth: Time-variation in Beta.

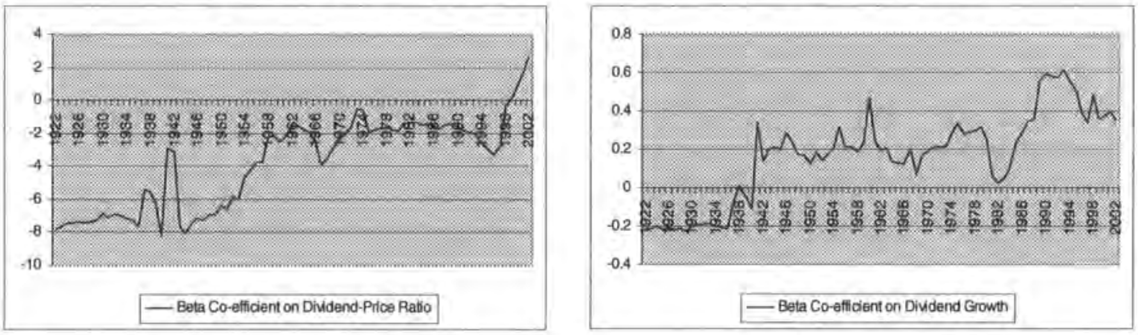
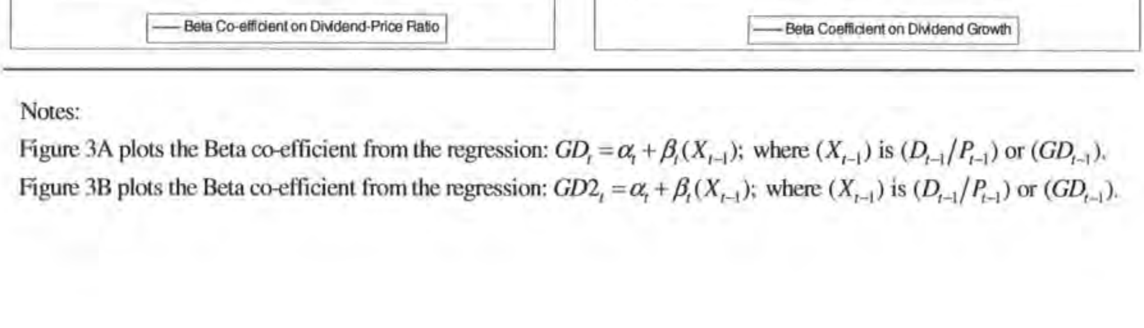



Figure 3B: Forecasting 2 Year Dividend Growth: Time-variation in Beta.




Notes:

Figure 3A plots the Beta co-efficient from the regression: $GD_t = \alpha_t + \beta_t(X_{t-1})$; where $(X_{t-1})$ is $(D_{t-1}/P_{t-1})$ or $(GD_{t-1})$.

Figure 3B plots the Beta co-efficient from the regression: $GD2_t = \alpha_t + \beta_t(X_{t-1})$; where $(X_{t-1})$ is $(D_{t-1}/P_{t-1})$ or $(GD_{t-1})$.

[22] Our in-sample results found $B_t$ on $D_t/P_t$ to be significantly negative for the 1902-1950 period.

The weak and sometimes perverse relationship between the dividend-price ratio and future dividend growth since the 1960s indicates that mean-reversion in the dividend-price ratio cannot be expected to be driven by adjustments in dividend payments, in breach of theory[23]. It appears that since the 1960s dividends have had little impact in driving the dividend-price ratio back to equilibrium. This is exactly the pattern we detected in our in-sample tests of 3.4.2.2 that post 1950 there was no statistically significant relationship between the dividend-price ratio.

At the two-year horizon we do find that the $\beta$ coefficients are negative and often of substantive magnitude throughout the pre 1950 sample period, supporting the pattern found at the one year horizon. This is in-line with the in-sample findings for the pre-1950 period that there was a statistically significant negative relationship between the dividend-price ratio and future dividend growth.

$$\begin{aligned} GD_t &= \alpha_t + \beta_t(GD_{t-1}) + \varepsilon_t \\ GD2_t &= \alpha_t + \beta_t(GD_{t-1}) + \varepsilon_t \end{aligned} \tag{23}$$

For previous dividend growth we expect that $\beta$ should be positive. Dividends tend to adjust only slowly over time and managers only tend to increase dividends at a rate they believe to be sustainable (Lintner, 1956). Figure 3.3A indicates that at the one year horizon $\beta$ on dividend growth was positive in each sample ending period since 1940. From the 1940's to the 1980s the $\beta$ coefficient tended to fluctuate around 0.2. However, during the 1990s the $\beta$ coefficients rise and are always above 0.35. This indicates that at the end of the sample period dividend growth has become increasingly persistent, strengthening the relationship between prior and current

[23] See Section 3.4.2.2 for a more detailed description of this.

dividend. However, before 1940, $\beta$ on dividend growth was negative contrary to our expectations at both the one year and the two-year horizon. Although the in-sample tests of 3.4.2 found past dividend growth to have little explanatory power over current dividend growth during the first half of the 20th Century.

At the two-year horizon we do find that $\beta$ tends to be small and hover around zero during the period 1940-1980, indicating the relationship during this period is weaker than at the one year horizon. However, since the mid-1980s there does appear to be much greater persistence in $\beta$ predicting dividend growth at the two-year horizon, with the coefficient estimate being above 0.2 throughout this period.

$$
\begin{aligned}
GD_t &= \alpha_t + \beta_t(R_{t-1}) + \varepsilon_t \\
GD2_t &= \alpha_t + \beta_t(R_{t-1}) + \varepsilon_t
\end{aligned}
\tag{24}
$$

The relationship between returns and dividend growth is a little less direct than that between the previous variables. If the current return is high then this could be due to an upward revision in expectations of the future performance of fundamentals, particularly earnings growth, which could feed higher future dividends. Thus, our expectation is that there is a positive relationship between the two variables. The in-sample results reported in Section 3.4.2 found no significant relationship between returns and dividend growth during the first half of the 20th Century, thus the relatively small coefficients found in figure 3 over this period are unsurprising. Nevertheless, the negative coefficients found in the early part of the sample do contradict our expectations.

Perhaps, most interestingly figure 3.3A suggests a strong link between the lagged return and one-year dividend growth from the 1940's to the 1970s as evidenced by a highly positive $\beta$ on returns, during this period. However, since 1980 the link between returns and dividend growth appears to have diminished, with the return $\beta$ being close to 0. It did remain positive but was small during the 1980s before turning negative, but of a negligible magnitude, during the mid-1990s. Consequently, it appears there is little, if any, relationship between returns and dividend growth from the mid-1990s onwards.

For two year average dividend growth, $\beta$ on returns is positive throughout the sample period of 1922-2000. This supports our hypothesis that current returns do contain useful information about future dividend growth and there is a positive relationship between the variables. As at the one year horizon the relationship appears strongest for sample periods ending between 1940 and 1979.

#### 3.4.3.4 OUT-OF-SAMPLE FORECASTING: PERFORMANCE EVALUATION METHODOLOGY

To compare the forecasts from our various models we can generate statistics that examine the magnitude of the forecasting errors. The first measure is simply the mean error, which simply tells us the average difference between the forecasted value and the actual value. This measure is not particularly informative about the accuracy of model forecasts since it allows forecast over-estimates and under-estimates to cancel out. Therefore a better measure is the mean absolute error, which takes into account the absolute deviation of each forecast error from the actual value and then takes the average. An alternative method which has similar benefits is the mean of squared errors. This takes into account both the absolute distance of any forecast error but also penalises larger forecast errors more heavily than smaller errors. To enable a degree of comparability of this measure with the mean absolute error then the root of the mean squared error can be used.

$$\text{Mean Error } = \frac{\sum \widehat{GD_t} - \sum GD_t}{n}$$

$$\text{Mean Absolute Error } = \frac{\sum \left| \widehat{GD_t} - GD_t \right|}{n}$$

$$\text{Mean Squared error: } = \frac{\sum [(\widehat{GD_t} - GD_t)^2]}{n}$$

$$\text{Root Mean Squared error: } = \sqrt{\frac{\sum [(\widehat{GD_t} - GD_t)^2]}{n}}$$

A crucial remaining issue is identifying if the forecasting accuracy of a particular model is statistically distinguishable from that of any other? This can be tested now by the Diebold-Mariano test (1995) developed under the null hypothesis that forecast a and forecast b are equally accurate forecasts. Our two sets of forecast errors $e_{at}$ and $e_{bt}$ provide the same quality of forecasts if E| $d_t$ | = 0, where $d_t$ = $e_{at}^2$ - $e_{bt}^2$ under the mean-squared error criterion. The test statistic is $S_1 = [\hat{V}(\bar{d})]^{-1/2}\bar{d}$, which follows a standard normal distribution.

Harvey, Leybourne and Newbold (1997) advocate modifying the Diebold-Mariano test to improve its finite sample performance. Their modification improves the estimation of the variance of $\bar{d}$, proposing the new test statistic: $S_1{}^* = \frac{n+1-2h+n^{-1}h(h-1)}{n} S_1$, where h is the number of steps ahead that are forecast. This new statistic, which follows the t-distribution, is confirmed by monte-carlo simulations to perform better than the original Diebold-Mariano statistic.

### 3.4.3.5. OUT-OF-SAMPLE FORECASTING 1 YEAR DIVIDEND GROWTH: RESULTS

For the whole sample period 1923-2002, we find that the mean error (see 3.4.3.4 for definition) for all models was positive. This demonstrates that these forecasting tools suggest that average annual dividend growth could have been expected to be up to 0.57% p.a. higher than it actually was! Considering that average dividend growth only averaged 0.98% p.a. for 1901-2002, this is quite a substantial amount. This suggests that rather than being phenomenally high, dividend growth was actually lower than expected during 1923-2002.

In terms of actual forecasting accuracy at the one year horizon, we find that the historical average model proposed by Fama and French is superior over the full sample period of 1923-2002. It has the lowest mean-squared error and the lowest mean absolute error (see 3.4.3.4 for definition) of 55.60% and 5.92% respectively. The three regression based forecasting models had very similar performance in terms of overall accuracy. In terms of mean-squared error the dividend-price model fared best with 61.47% followed by the dividend model with 63.99% and then the return model with 66.20%, whilst in terms of mean absolute error all three were almost identical being between 6.27% and 6.37%. The naïve random walk model performed very poorly having the largest statistics of 80.80% for mean-squared error and 6.89% for mean absolute error.

However, when we split the sample into two sub-periods a slightly different picture emerges. For 1923-1950, the dividend-price model provides the most accurate one step ahead dividend growth forecasts. Its mean squared error of 53.82% is much smaller than that of the other models and its mean absolute error of 6.20% is also the lowest. The historical average model is second best whilst the dividend model and return model produce poor forecasts which are only surpassed by the naïve model. Over 1951-2002, the historical average model provides the lowest forecast errors in terms of mean squared error with 49.37%, with the return model and dividend model closely following with 52.26% and 52.90%. However, the return model has the smallest mean absolute error of 5.45% followed by the historical average model with 5.58% and then the dividend model with 5.86%. Somewhat surprisingly the random walk model had a reasonable degree of accuracy over the 1951-2002 period, outperforming the dividend-price model in terms of both mean squared error, 62.69% compared to 65.58%, and mean absolute error, 6.17% as opposed to 6.46%.

The performance of the three regression models in the sub-samples are as one would expect given the results of the in-sample tests. The dividend-price model performs well over 1923-1950, the period when in-sample tests demonstrated it had some predictability over dividend growth, while it performed poorly over 1951-2002 when in-sample tests indicated it was unable to predict dividend growth. The return and dividend models followed a similar pattern performing well when the in-sample tests had indicated they had forecasting power during 1951-2002 and performing poorly in the early sample period when in-sample tests had found no predictability. However, what is surprising is that the historical average model performs so well and is able to outperform the forecasts of the return and dividend model over the 1951-2002 period.

## TABLE 3.6: ONE YEAR DIVIDEND GROWTH FORECASTING PERFORMANCE

| 1923-2002<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 61.47% | 63.99% | 66.20% | 80.80% | 55.60% |
| Mean Error | 0.57% | 0.46% | 0.49% | 0.02% | 0.31% |
| Mean Absolute Error | 6.37% | 6.27% | 6.27% | 6.89% | 5.92% |
| Root Mean Squared Error | 7.84% | 8.00% | 8.14% | 8.99% | 7.46% |

| 1923-1950<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 53.82% | 82.41% | 85.31% | 114.44% | 67.17% |
| Mean Error | 1.86% | 1.63% | 0.88% | 0.02% | 0.86% |
| Mean Absolute Error | 6.20% | 6.86% | 7.37% | 8.23% | 6.55% |
| Root Mean Squared Error | 7.34% | 9.08% | 9.24% | 10.70% | 8.20% |

| 1951-2002<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 65.58% | 52.90% | 52.26% | 62.69% | 49.37% |
| Mean Error | -0.13% | -0.14% | 0.13% | 0.03% | 0.01% |
| Mean Absolute Error | 6.46% | 5.86% | 5.45% | 6.17% | 5.58% |
| Root Mean Squared Error | 8.10% | 7.27% | 7.23% | 7.92% | 7.03% |

Now we turn our attention to whether or not the forecast errors are statistically distinguishable from each other. For this we use the Harvey et al.'s modified Diebold-Mariano test for which results are reported in Table 3.7.

For the full sample, these tests indicate that the historical average model, which had the lowest mean-squared error, provides statistically significantly better forecasts than the dividend model and the naïve model. However, all the other models are found to provide forecasts that are statistically equally accurate according the modified Diebold-Mariano test. Thus, we are unable to claim unambiguously that the historical average model provides the best forecasts because we are unable to reject the null that the historical average model produces superior forecasts to either the dividend-price model or the returns models over the full sample period.

# TABLE 3.7: ONE YEAR DIVIDEND GROWTH - TESTS OF EQUAL FORECAST ACCURACY

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Historical | Dividend | -1.83 | -1.67 | Historical Forecast are more accurate |
| 1923-1950 | Historical | Dividend | -1.70 | -1.70 | Historical Forecast are more accurate |
| 1951-2002 | Historical | Dividend | -0.84 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Historical | Returns | -1.13 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Historical | Returns | -2.31 | -1.70 | Historical Forecast is more accurate |
| 1951-2002 | Returns | Historical | -0.25 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Historical | Dividend-Price | -0.88 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Historical | Dividend-Price | 1.02 | -1.70 | Forecasts have equal accuracy |
| 1951-2002 | Historical | Dividend-Price | -2.25 | -1.70 | Historical Forecast are more accurate |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Dividend | Dividend-Price | 0.23 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Dividend-Price | Dividend | -1.72 | -1.70 | Dividend-Price forecast is more accurate |
| 1951-2002 | Dividend | Dividend-Price | -1.77 | -1.70 | Dividend Forecast is more accurate |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Returns | Dividend-Price | 0.43 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Dividend-Price | Returns | -2.12 | -1.70 | Dividend-Price forecast is more accurate |
| 1951-2002 | Returns | Dividend-Price | -0.95 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Returns | Dividend | 0.33 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Returns | Dividend | 1.03 | -1.70 | Forecasts have equal accuracy |
| 1951-2002 | Returns | Dividend | -0.01 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Returns | Naïve | -0.97 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Returns | Naïve | -0.82 | -1.70 | Forecasts have equal accuracy |
| 1951-2002 | Returns | Naïve | -0.57 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Dividend | Naïve | -1.35 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Dividend | Naïve | -1.09 | -1.70 | Forecasts have equal accuracy |
| 1951-2002 | Dividend | Naïve | -0.78 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Dividend-Price | Naïve | -1.33 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Dividend-Price | Naïve | -2.38 | -1.70 | Dividend-Price forecasts are more accurate |
| 1951-2002 | Dividend-Price | Naïve | 0.17 | -1.70 | Forecasts have equal accuracy |

| Sample | Forecast 1 | Forecast 2 | Test-stat | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Historical | Naïve | -1.87 | -1.67 | Historical forecasts are more accurate |
| 1923-1950 | Historical | Naïve | -1.84 | -1.70 | Historical forecasts are more accurate |
| 1951-2002 | Historical | Naïve | -0.86 | -1.70 | Forecasts have equal accuracy |

For the 1923-1950 period we find that the dividend-price forecast is statistically superior to the dividend, return and naïve models, and that the historical average forecast is also superior to these three models. However, for the dividend-price and the historical average models we find we cannot reject the null hypothesis that they produce equally accurate forecasts. The implication of these results is that rational investors in 1950 attempting to predict future dividend growth have sufficient information to know that the dividend-price model or the historical average model will provide them with the best short-term forecasts.

Over 1951-2002 we find that the dividend-price forecasts are inferior to the historical average model and the dividend model. However, all other combinations of models are found to produce equally accurate predictions. Given that the historical average, dividend and returns model all had broadly similar mean-squared errors then perhaps investors in 2002 might consider the predictions of all three models when assessing the prospects of future dividend growth. However, it should have become clear by 2002 that the dividend-price ratio is no longer a useful forecaster of future dividend growth.

### 3.4.3.6. OUT-OF-SAMPLE FORECASTING 2 YEAR DIVIDEND GROWTH: RESULTS

When considering average dividend growth over the next two years we find that the historical average model has the smallest mean-squared error both in the full sample and in the two sub-samples, and also has the lowest mean absolute error in all periods. In terms of the modified Diebold-Mariano tests for the full sample period, the historical average model is found to be statistically superior to the dividend-price, dividend and naïve models. Only, for the return model are we unable to reject the null hypothesis that both models provide equally good forecasts.

Perhaps surprisingly the return model provides the second most accurate forecasts in all periods by both the mean-squared error and mean absolute error approach. This is surprising for the pre-1950 period because our in-sample tests indicated that there was little relationship current returns and subsequent two year dividend growth. Furthermore, the theoretical link between current returns and future dividend growth is less direct than between other variables. The explanation for the link between the two, in our opinion stems from current returns often being generated in response to changes in expectations of future earnings growth, which feeds into future growth in dividends. In terms of the modified Diebold-Mariano tests for the full sample period and all sub-periods, we find that the model provides equally accurate forecasts as the historical average, dividend-price and dividend models. Its forecasts are only found to be superior to the naïve model.

The dividend-price ratio performed disappointingly when predicting two year average future dividend growth. Even during the pre-1950 period when it exhibited in-sample predictability we find that in terms of forecasting it was outperformed by both the historical average model and the returns model according to the mean-squared error and mean absolute error criterion. For the full sample period its forecasting performance was also worse than the dividend model, while for the post-1950 sample it generated the worst forecasts, worse even than the naïve random-walk model. Nevertheless, for the full sample period only the historical average model was deemed to provide statistically superior forecasting power, while the dividend-price model was found to give more accurate forecasts than the naïve model.

## TABLE 3.8: TWO YEAR DIVIDEND GROWTH FORECASTING PERFORMANCE

| 1923-2001<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 63.49% | 47.16% | 42.53% | 79.03% | 37.35% |
| Mean Error | 0.46% | 0.52% | 0.55% | -0.04% | 0.22% |
| Mean Absolute Error | 6.31% | 5.46% | 5.30% | 7.00% | 5.02% |
| Root Mean Squared Error | 7.97% | 6.87% | 6.52% | 8.89% | 6.11% |

| 1923-1950<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 50.31% | 54.50% | 44.23% | 108.13% | 39.62% |
| Mean Error | 1.37% | 1.44% | 1.30% | -0.02% | 0.82% |
| Mean Absolute Error | 6.04% | 5.59% | 5.23% | 8.19% | 5.06% |
| Root Mean Squared Error | 7.09% | 7.38% | 6.65% | 10.40% | 6.29% |

| 1951-2001<br>Statistic | Dividend-Price<br>Model | Dividend<br>Model | Return<br>Model | Naïve<br>Model | Historical Av.<br>Model |
|---|---|---|---|---|---|
| Mean Squared Error | 70.73% | 43.12% | 41.59% | 63.06% | 36.10% |
| Mean Error | -0.03% | 0.01% | 0.14% | -0.05% | -0.11% |
| Mean Absolute Error | 6.45% | 5.39% | 5.34% | 6.35% | 5.00% |
| Root Mean Squared Error | 8.41% | 6.57% | 6.45% | 7.94% | 6.01% |

### 3.4.3.7 OUT-OF-SAMPLE FORECASTING CONCLUSION:

Our results support the hypothesis that there is no better forecaster of future dividend growth than its historical average. For forecasts of dividend growth at both the 1 year and 2 year horizon over the full sample the historical average model had the lowest mean-squared error and mean absolute error. Even during sub-periods, such as for 1923-1950 forecasts of 1 year dividend growth when the dividend-price model provided the lowest performance statistics, the statistical test of equal performance failed to reject the null that both the dividend-price and the historical average model provided forecasts of equal quality.

The historical average dividend growth rate stood at 1.2% p.a. in 1951, it was almost unchanged in 2002 nudging marginally higher to 1.3%p.a. The growth rate for

1951-2002 was 1.4% p.a. Thus, although the actual dividend growth rate might have been above investors' expectations, it was only by a negligible amount.

## TABLE 3.9 TWO YEAR DIVIDEND GROWTH – TESTS OF EQUAL FORECAST ACCURACY

| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
|---|---|---|---|---|---|
| 1923-2002 | Historical | Dividend | -2.37 | -1.67 | Historical Forecast are more accurate |
| 1923-1950 | Historical | Dividend | -1.45 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Historical | Dividend | -2.29 | -1.70 | Historical Forecast are more accurate |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Historical | Return | -1.29 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Historical | Return | -0.84 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Historical | Return | -1.00 | -1.70 | Forecasts have equal accuracy |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Historical | Valuation | -2.13 | -1.67 | Historical Forecast are more accurate |
| 1923-1950 | Historical | Valuation | 0.43 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Historical | Valuation | -2.82 | -1.70 | Historical Forecast are more accurate |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Dividend | Valuation | -0.40 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Valuation | Dividend | -1.63 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Dividend | Valuation | -1.81 | -1.70 | Dividend Forecasts are more accurate |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Return | Valuation | -1.04 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Valuation | Return | -0.96 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Return | Valuation | -1.65 | -1.70 | Forecasts have equal accuracy |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Return | Dividend | -1.02 | -1.67 | Forecasts have equal accuracy |
| 1923-1950 | Return | Dividend | -1.47 | -1.70 | Forecasts have equal accuracy |
| 1951-2001 | Return | Dividend | -0.26 | -1.70 | Forecasts have equal accuracy |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Return | Naïve | -3.05 | -1.67 | Return Forecasts are more accurate |
| 1923-1950 | Return | Naïve | -2.60 | -1.70 | Return Forecasts are more accurate |
| 1951-2001 | Return | Naïve | -1.72 | -1.70 | Return Forecasts are more accurate |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Dividend | Naïve | -2.57 | -1.67 | Dividend Forecasts are more accurate |
| 1923-1950 | Dividend | Naïve | -1.98 | -1.70 | Dividend Forecasts are more accurate |
| 1951-2001 | Dividend | Naïve | -1.65 | -1.70 | Forecasts have equal accuracy |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Valuation | Naïve | -2.08 | -1.67 | Valuation forecasts are more accurate |
| 1923-1950 | Valuation | Naïve | -2.82 | -1.70 | Valuation forecasts are more accurate |
| 1951-2001 | Valuation | Naïve | -0.35 | -1.70 | Forecasts have equal accuracy |
| | Model 1 | Model 2 | Test Statistic | Critical Value | Conclusion |
| 1923-2002 | Historical | Naïve | -3.61 | -1.67 | Historical forecasts are more accurate |
| 1923-1950 | Historical | Naïve | -3.13 | -1.70 | Historical forecasts are more accurate |
| 1951-2001 | Historical | Naïve | -2.08 | -1.70 | Historical forecasts are more accurate |

### 3.4.4 DO EXPECTED STOCK RETURNS FALL DURING THE 1951-2002 PERIOD?

If we examine in more detail the relationship between a change in expected returns and share prices indices; we note that a change in expected returns will trigger an unanticipated capital gain or loss in a well-functioning capital market. For example if a share is simply valued according to the discounted value of all its future payoffs, now suppose there is a fall in expected returns then future payoffs are discounted at a lower rate meaning that the price of the asset must rise. This rise in the price of the asset is unexpected and unanticipated; it is simply good fortune caused by the decline in expected returns.

However, studies of the equity premium tend to analyse the premium using about 100 years of data. Over such long sample periods one would expect these unexpected gains and losses to cancel out, thus rendering realised returns as an appropriate proxy for expected returns over extended time periods.

Although, if expected returns have declined on average over time this would not be the case. A stream of unexpected capital gains may have been triggered causing realised historical returns to be substantially above investors expectations. In these circumstances estimations of the equity premium implied by fundamentals, which are essentially unaffected by changes in expected returns, will give us estimates of the true *ex ante* risk premium that are not contaminated by unanticipated share price appreciation. As outlined below there are a number of reasons to suggest that the cost of equity capital has fallen over recent decades causing unexpected rises in rationally valued shares.

There have been a number structural changes to the economies of the World's leading nations over the last century. For example, the threat of another World War has subsided considerably over the past 50 years. Alternatively perhaps increasing globalisation, openness and integration of markets around the world has enabled investors to seriously consider investing in countries they would've been reluctant to supply funds to 30 or 40 years ago (Stulz, 1999). In addition, greater opportunities for portfolio diversification which now exist (Merton, 1987). Bansal and Lundblad (2002) provide evidence that the international ex ante risk premium on the global market portfolio has dropped considerably; they show this is linked to a decline in the conditional variance of global real cashflow growth rates. The level of currency risk in some countries may also have declined. Sentana (2002) suggests that the introduction of the EMS and the consequent reduction in currency risk has lead to a moderate drop in the cost of capital for 10 European countries, which supports the findings of Antoniou et al (1998) for the UK market. Furthermore transaction costs have declined as pointed out by Aiyagari and Gertler (1993) and Jones (2000), which have effectively lowered the rate of return demanded by investors.

If factors such as these have occurred, then it is quite plausible that the cost of equity capital has fallen. If this has occurred during the latter part of the 20$^{th}$ Century, then this would stimulate rises in the equity price index unforeseen by rational investors. Thus, the true *ex-ante* equity premia might be considerably below the 6-8% estimates based upon historical investment returns. If this is the case then the magnitude of the equity premium puzzle will have been overstated by studies which have employed historical returns. Thus, the equity premium puzzle is likely to be smaller than previously thought.

We examine the dividend-price ratio to assess if there has been any permanent change in the level of expected returns. Figure 3.1 shows that there does appear to have been a declining trend in the UK Dividend-price ratio since the 1980s. In every year since 1992 the UK dividend-price ratio has been below its historical average of 4.42%, reaching a post-war low of 2.06% in 1999. However, the decline in the UK dividend-price ratio does not appear to be as clearly prevalent or severe as the decline of the US dividend-price ratio. For example, Fama and French's sample finished in 2000, at which point the S&P 500 dividend-price ratio was at an all-time minima of 1.1% and even by the end of 2002 it had remained below 1.5%. Our conjecture is that part of the decline in the US dividend-price ratio can be assigned to a change in the payout policy of American firms that has not been paralleled by their British counterparts[27]. Nevertheless, it appears that since the early 1990s both the UK and the US dividend-price ratio have been fluctuating around a lower mean value. This is indicative that, in fact, the discount rate has fallen.

As alluded to in Chapter 3.2.5 there are several outlying observations in the Barclays dividend-price ratio. These correspond to World War 1 and its immediate aftermath for the years 1915, 1919 1921. There is also a large outlying observation in 1974, due to the 1st OPEC oil crisis and subsequent UK market crash. Since outliers can seriously damage the ability of structural break tests to correctly detect the true date of the change we therefore insert dummy variables for these years to neutralise the effects of these extreme observations. The approach employed is given by equation 25.[28]

---

[27] This issue is discussed in more detail in Chapter 3.3.1

[28] For a more detailed description of the formation of the DPDUM series we refer the reader to Chapter 3.5.

$$
\begin{aligned}
&D_t / P_t = \alpha + \beta_1.(1915D) + \beta_2.(1919D) + \beta_3.(1921D) + \beta_4.(1974D) + \varepsilon_t \\
&DPDUM = D_t / P_t - \beta_1.(1915D) - \beta_2.(1919D) - \beta_3.(1921D) - \beta_4.(1974D)
\end{aligned} \tag{25}
$$

The resultant series, DPDUM is stationary (as reported in Section 3.5) and thus can be appropriately used to test for breaks. We utilise the Andrews-Quandt structural stability tests which searches for the break date which maximises the F-value of the Chow test.

Under the Chow test the null hypothesis is that there is no structural break, which for our application we are testing if there is any change in the mean of the dividend-price ratio. In order to test if there is a structural break we suppose there is a break in time period $n_1$. A dummy variable $D_t$ is then included in the regression with takes the value of 0 prior to the structural break i.e. for t=1902,1903… $n_1$; the dummy variable is 1 for t= $n_1+1$, $n_1+2$…2002. This specification we refer to as the New regression, which can be compared with the Old specification which has no structural break.

$$
\begin{aligned}
&Old)\ DP4DUM = \alpha + \varepsilon_t \\
&New)\ DP4DUM = \alpha + \beta D_t + \varepsilon_t
\end{aligned}
$$

We then use an adjusted F-test to assess if the inclusion of the dummy variable has reduced the residual sum of squares by a statistically significant amount. The F-Test statistic is given by:

$$F_{k,T-2k} = \frac{(RSS_{old} - RSS_{new})/k}{RSS_{new}/T-2k}$$

k = number of parameters (26)

T = number of observations

RSS = residual sum of squares

The Andrews-Quandt test assumes the break date is unknown, and calculates the Chow test for every possible break date[29], it chooses the break date which maximises the F-test statistic. This test-statistic can then be compared with the critical value from the F-distribution with k,T-2k degrees of freedom to infer if the break date selected is statistically significant. If the test statistic > critical value then we reject the null hypothesis and conclude that there has been a statistically significant structural break. We should then employ the New regression specification.

More sophisticated structural break tests than Andrews-Quandt have recently been developed. For instance there are now structural stability tests that allow for multiple breaks (Bai and Perron (1998, 2004). These tests have been employed in Chapters 4 and 5 of this thesis, however, we can report that these more sophisticated tests fail to detect more than a single break in the dividend-price series examined in Chapter 3. Thus, the key inferences made in Chapter 3 using the Andrews-Quandt test are the same as those had the Bai and Perron (1998, 2004) methodology been adopted in the current Chapter.

[29] The first and last 15% of observations are excluded in order that erroneous breaks are not found.

## TABLE 3.10: ANDREWS-QUANDT TESTS

| Dependent Variable | Sample Period | Break Date | Break Parameter | Andrews-Quandt Test Test statistic | p-value | Inference |
|---|---|---|---|---|---|---|
| Barclays DPDUM | 1902-1951 | 1919 | Constant | 1.94 | 0.80 | Break is statistically insignificant |
| Barclays DPDUM | 1952-2002 | 1992 | Constant | 20.45 | 0.00 | Break is statistically significant |

Our equity premium results from Chapter 3.3.1 indicated equity premia results diverged for the post-1950 period but were approximately the same for the pre-1950 period. Since we are concerned with uncovering what could have caused this disparity in the second half of the 20th Century, we split our sample in half and run the structural break test on each sub-sample.[30]

The Andrews-Quandt test fails to detect a significant break in the mean of the dividend-price ratio during the period 1902-1951. However, over the period 1952-2002, 1992 is selected as the break date with a p-value of 0.0002.

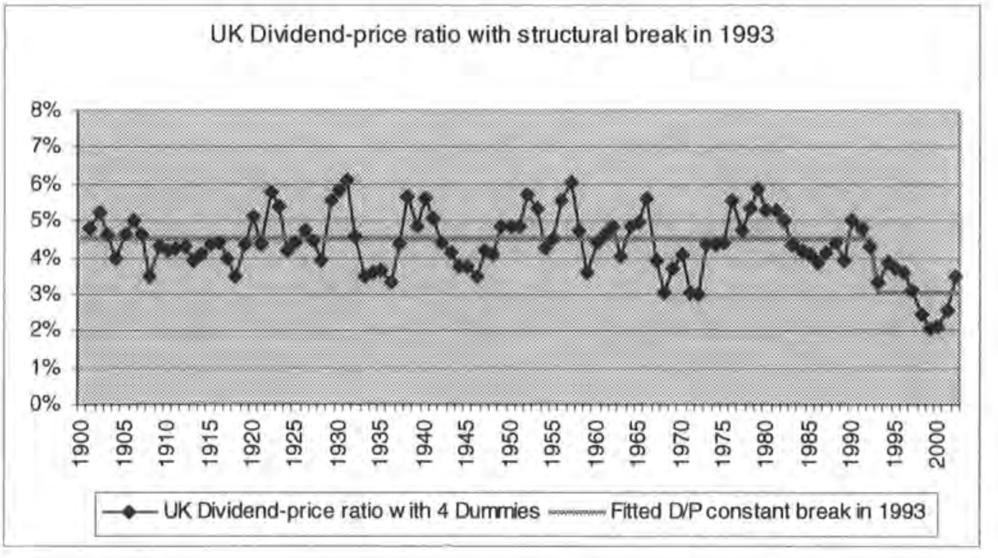
$$
\begin{aligned}
&D_t/P_t = \alpha + \beta 1993D + \varepsilon_t \\
&\text{Dividend-price ratio with 1993 break} = \alpha + \beta 1993D
\end{aligned}
\qquad (27)
$$

Equation 27 gives our new line of best fit for the dividend-price ratio. The dummy variable 1993D takes the value of 0 for $t \leq 1992$ and 1 for $t \geq 1993$.

When we use a post-1992 break in the mean of the dividend-price series, visual inspection of figure 3.4 demonstrates the shift appears to fit the data extremely well. Therefore it appears as if a break in the dividend-price ratio ratio did occur in the early 1990s.

[30] When we run the test on the full sample (1902-2002) we discover a statistically significant break is detected in 1985 with a 0.000 p-value. However, this break appears to provide a poor fit to the data probably since the break tests exclude the first and final 15% of observations and hence can't detect a break in the series any later than 1985. Therefore the results reported in the text appear most appropriate and appear to date the break most accurately.

**FIGURE 3.4: UK DIVIDEND-PRICE RATIO WITH 1993 BREAK.**




Our evidence lends support to the hypothesis that expected returns have fallen. The break tests indicate a downward shift in the mean of the dividend-price ratio by the value of *B*, of approximately 1.5%, which is economically substantial particularly given the previous mean of the dividend-price ratio was about 4.5%. This evidence supports the notion that future cashflows are being discounted by investors at a lower rate. If this is the case rationally valued equities would witness a run-up in prices during the late 20$^{th}$ Century, due to factors not anticipated by investors. This appears to match exactly the empirical observations of rising stock market indices during the 1990s and can be attributed to investor's revising downwards their expectations of future returns.

Our break-point test findings are entirely consistent with the US study of Carlson, Pelz and Wohar (2002) who document that valuation ratios have shifted to permanently lower values. They examined the quarterly dividend-price ratio finding support for a single break in the data. The timing of their break date in the early 1990s appears to coincide almost exactly with our contention that the UK dividend-price ratio suffered a downward shift in mean in 1992. This is suggestive that perhaps there were common factors at work in both markets that might have lead to such a shift.

However, whilst we do not examine precisely what has caused the fall in discount rates; we do propose that there are several factors which potentially these findings could be attributed to: increased international political stability, increasing globalisation of economic production, greater openness of international financial markets and increased opportunities for portfolio diversification or declining transaction and information costs. We leave the avenue open for further research to attempt to pinpoint the exact cause of the decline in expected returns. Our main conclusion is purely that there is good reason to believe that expected stock returns have declined towards the end of the 20$^{th}$ Century. Such a decline in expected returns could rationally explain why stock prices rose so rapidly during the 1990s and why realised returns over the period 1951-2000 have exceeded investors' expected returns as proxied for by the dividend model.

## 3.5 CONCLUSION

The empirical research presented in this Chapter suggests that the UK equity premium since 1951 has been much higher than could be expected. We suggest that annual expected market equity premium was most likely to be in the region of 4.6%, our estimate of the dividend growth model rather than the 7.79% investors' actually received. We document for the overall market that the pace of capital gains has been dramatically higher since 1951 than the period prior preceding 1950. This is thought to have been largely unanticipated by economic agents and certainly it cannot be justified by in-sample growth of dividends since 1951.

We argue that the average stock return since 1951 was above investors' expectations and investigate if this was due to either a) expectations of higher growth rates of fundamentals post-2002 or b) a decline in the discount rate.

We find some evidence of in-sample dividend growth predictability at one or two year horizons during each sub-period. Since 1951, lagged returns and lagged dividend growth are found to be significantly and positively related to dividend growth. However since 2000, both returns and dividend growth have been below long-run average thus these models suggest investors should expect lower than average dividend growth in the future. Out-of-sample the historical dividend growth rate is the best forecaster of future dividend growth especially since 1951 and especially for horizons longer than one year. This provides evidence to refute the hypothesis that dividend growth should be especially high in the future. Since the historical dividend growth is the best forecaster then investors should expect dividend growth rates to be approximately the same as in the past. In short we find no evidence whatsoever to support the view that future dividend growth should be any higher than its historical average.

We find support for the hypothesis that expected returns have fallen. There appears to be a permanent decline in the dividend-price ratio as identified by the structural break test, which would indicate that the expected unconditional equity return has fallen. We propose that this is the primary cause of the high level of capital growth witnessed since 1951, which we believe to have been largely unanticipated by potential investors in 1950. These findings of course feed through to the expected equity premium. If expected returns have fallen then the equity premium, the return in excess of the risk-free rate will, *ceteris paribus*, also be lower. This has important consequences for many economic agents. For financial directors of corporations it means they should be able to raise equity capital more cheaply than implied by the historical equity premium. However, for members of private pension schemes it suggests that projections based upon the historical equity premium will have to be revised downwards. Therefore, pension members will either will have to save more to provide the same benefits or settle for a lower pension during retirement. Hence, the key implication of this Chapter is that unless UK investors believe that valuation ratios will halve again, they should expect a lower equity premium in the future.

# CHAPTER 4: THE EQUITY PREMIUM - UK INDUSTRY EVIDENCE.

## 4.1 INTRODUCTION

Recent US research has suggested that the aggregate equity premium and aggregate expected returns have fallen (see Fama and French (2002), Arnott and Bernstein (2002) amongst others). Chapter 3 of this thesis provides evidence from the UK consistent with the view that the historical equity premium over the latter part of the 20$^{th}$ Century was above the expected equity premium implied by fundamentals; subsequent analysis suggests that expected returns and hence the expected equity premium had fallen in the UK consistent with the conclusions of Fama and French (2002). Other recent studies also suggest a fall in expected returns occurred during the early 1990s in the US (Lettau, Ludvigson and Wachter (2006)) and globally (Bansal and Lundblad (2002)).

Our most important innovation and extension of the prior literature and our study in Chapter 3 of this thesis is to present an industry analysis of the equity premium. The key issue we address in this Chapter is whether the *historical* equity premium earnt by individual industries is consistent with the *expected* equity premium for that industry. The equity premium earnt by individual industries has implications for various stakeholders. Corporate treasurers use the firm's cost of equity capital for investment appraisal and financing purposes. However, estimates of the firm cost of equity capital are usually based upon estimates of the equity premium for their industry. If there has been a fall in expected returns and the expected equity premium then this should benefit all industries via a lowering of the cost of equity capital. A fall in the cost of equity capital enables corporate treasurers to raise funds for new investment more cheaply. This thesis chapter enables us to assess the extent to which the cost of equity capital has fallen across UK industries.

To private investors looking to invest long-term whether the historical performance of particular industries is commensurate with what could be expected is also of practical interest. An anecdotal example of the dangers of investing based upon purely upon prior historical return performance can be seen from technology investment funds marketed around the turn of the Millenium in 2000. High technology firms earnt extremely high returns during the 1990s. Perhaps, many investors thought this recent performance would continue and would look favourably upon investing in technology funds. However, these high returns were not supported by fundamentals; many tech stocks have never paid a dividend nor reported a profit. Hence, it was unlikely that these stocks could be expected to continue to generate high returns into the future. With the benefit of hindsight we can see that these stocks have earnt very low returns since the late 1990s. While our study examines a much longer timeframe than this example, it does serve to highlight the importance, necessity even, of estimating the expected equity premium as well as the historical average equity premium in order for more informed asset management decisions to be made.

We use a cross-section of 16 narrowly defined industry groupings enabling a rich and comprehensive analysis. Special effort is devoted to data collection to ensure both live and dead firms are included in the analysis, in order to avoid much of the survivorship bias inherent in the Datastream compiled industry indices which only include firms currently trading.

The empirical analysis questions whether findings made using aggregate market indices are apparent in the cross-section of UK industries. In particular, our results question assertions from the prior literature that a) over recent decades there has been a general or overall fall in expected returns and b) there was a decline in expected returns during the 1990s. Specifically, our findings on the question of an overall fall in equity premium over 1966-2002 depends upon the measure of fundamentals used. For the majority of UK industries the earnings growth model suggests that for most industries the equity premium earnt over 1966-2002 was expected. In contrast the dividend growth model suggests that there could have been a fall in expected equity premia consistent with prior aggregate market findings. On the second issue of whether a fall in expected equity premium occurred during the 1990s this Chapter's analysis suggests if a fall occurred it occurred prior to the 1990s. Both dividend and earnings based results provide little support for a fall in equity premium during the 1990s.

The literature on the US equity premium has expanded considerably over recent years. Contemporary studies tend to focus one of two issues either a) what equity premium (if any) can be expected in the future or b) whether the historical equity premium could have been expected to be as high as was observed in the 20th Century. In relation to the first literature studies by Gebhardt et al. (2001), Claus and Thomas (2001) and Arnott and Bernstein (2002) broadly support the notion that at the start of the new millennium the equity premium should be lower than its historical average. The second question addressed by Jagannathan et al. (2001) and in more depth by Fama and French (2002) suggest that historical equity premia were higher than expected in the late 20th Century since stock price appreciation has not been supported by growth in economic fundamentals such as dividends or earnings.

This thesis chapter focuses upon this second issue of whether the historical equity premium observed in the latter 20th Century could have been expected to be as high as it was. In contrast, to almost all prior studies we examine the UK market rather than the US enabling us to examine how well Fama and French's results translate to countries outside of North America. We follow the approach of Fama and French (2002) and use both dividend and earnings growth to estimate expectations of capital gains. There are benefits and drawbacks relating to each measure of fundamentals. Nevertheless, the use of earnings growth as a proxy for expected capital gains is to our knowledge a new approach to estimating the UK equity premium. Earnings growth, we propose, also has some advantages over dividends as a measure of fundamentals. Firstly, dividends are arbitrary payments unlike earnings which are based on independently audited figures, secondly earnings are unaffected by changes in payout policy (such as the recent growth of share repurchases) and thirdly they are less susceptible to 'management' or 'smoothing' by boards of directors. Nevertheless despite these apparent benefits of earnings vis-à-vis dividends; dividends also have some advantages. Firstly, dividends are cash payments to investors whereas earnings are don't guarantee any actual payout to investors will occur. Secondly, earnings can be manipulated and the instances of such management appear to increase during the latter part of our sample (Berenson, 2004). Therefore, we report and interpret the results for both dividend and earnings based measures of the equity premium.

Have historical returns in most UK industries been considerably higher than those expected by investors over 1966-2002? Are these industry equity premium results consistent with those from prior aggregate market studies (for US, Fama and French (2002) and Jagannathan et al. (2001) and for UK Chapter 3 of this thesis)? If these market results were caused by a common risk factor then they should be generalisable across industry (or other portfolio) groupings.

Does a disparity exist between equity premium estimates from fundamentals and historical data over the period 1966-2002 across industries? Over the last 40 years there have been industries that have grown from being relatively small and unimportant[31] on the LSE to becoming of major importance. For example, the pharmaceutical, media and leisure industries have grown rapidly over recent decades becoming some of the largest sectors by market capitalisation by the turn of the 21st century. Whilst others have suffered major decline, for instance the mining and automotive industries. How pervasive are the market results? Is it just in industries experiencing major structural change that realised returns diverge from those implied by the earnings growth model? Or has this phenomenon been pervasive across the majority of industries? If the market results are pervasive across industries this would suggest they have been caused by a common economic risk factor if not they could be due to idiosyncratic industry effects.

Our analysis then seeks to prescribe the cause of any disparities found between historical returns and those implied by fundamentals. Firstly, we examine if fundamental growth is expected to be especially high in the future. We provide evidence that earnings growth is highly predictable in-sample. Moreover, forecasts from these models suggest that in some industries where the discrepancy between premia estimates was large (and positive), fundamental growth is expected to be high. Part of the high capital gains witnessed over recent years appears due to expectations of high future fundamental growth.

Secondly, we attempt to uncover if a change in expected returns has occurred. A related literature examines if there has been structural breaks in valuation ratios (earnings-price or dividend-price). Such a structural change is indicative of a change

[31] Some were virtually non-existent forty years ago such as IT.

in expected returns. We provide evidence of multiple regimes in valuation ratios of both the aggregate market and almost all industries over 1966-2002. Similarly to studies of the market (Carlson, Pelz and Wohar, (2002) and chapter 3 of this thesis, we find a common downward break in the market indices in the early 1990s. However, the majority of industries don't have a break in the 1990s, questioning if the market break is related to a common risk factor. Furthermore, although in almost all industries we do find structural breaks prior to the 1990s, overall there is little evidence of a fall in earnings-price over 1966-2002. This is indicative that overall expected returns haven't fallen during this period contrary to prior US aggregate studies.

## 4.2 DATA DESCRIPTION AND METHODOLODY

### 4.2.1 DATA DESCRIPTION

Our data was collected from Datastream. However we don't use the Datastream compiled industry indices which have been used in many previous studies (including Fletcher and Kihanda (2005) and Hong et al. (2006)). This is because of the survivorship bias inherent in these indices due to them only including live firms (i.e. those which are still currently trading). This 'survivorship bias' is compounded since they are only based on the 550 largest companies which are then split into industry groupings. In order to mitigate concerns of such a survivorship bias in our sample we compile industry portfolios ourselves. Firstly, we list all UK firms (in their database) trading on the LSE at any time between 1966-2002. Therefore our sample includes companies still trading as well as those that delisted. Financial firms are discarded[32], in line with similar studies, due to them having much greater scope for earnings management than 'real' economy firms. Thus, a total of 2,925 firms are included in the sample, of which 1,920 had delisted and 1,005 were still trading in the market. For each of these firms, we collected price, dividend-price, price-earnings and market capitalisation data from the Datastream database. Importantly, our dataset is free from the survivor bias inherent in the Datastream quoted industry indices.

Firms were then split into industries based upon the Financial Times Industry Groupings.[33] We include individually the 14 industries, which had at least 8 active companies at the sample start date[35]. The exception to this is the Pharmaceutical industry which initially had only 5 firms, however given the tendency for this industry to be relatively large in terms of market capitalisation and important economically we include it in its own right. Remaining industries were grouped according to whether they were services or goods / resources and are referred to as 'other services' and 'other goods' making a total of 16 portfolio groupings listed in Table 4.1.

Panel A of Table 4.1 provides descriptive statistics on the numbers of firms within an industry during the sample period. There is considerable variation in the average number of firms within each industry. Pharmaceuticals, Aerospace and Beverages all have fewer than 20 firms on average, whereas Construction and Engineering have around 100 firms or even more. There is also substantial time-variation in the number of firms within an industry; typically the maximum number of firms is several times larger than the minimum. Sub-sample averages also reflect this

[32] As is common in similar studies see e.g. Fama and French (1993).
[33] Datastream Level 4 industry classifications were identical to the Financial Times when data collected.
[35] Of these only Aerospace & Defence, Oil & Gas and Pharmaceuticals & Biotech had fewer than 12 firms at any point during the sample.

with the average number of firms for most industries being much lower over 1966-1978 than subsequent years. This reflects the relatively limited coverage of smaller firms by Datastream prior to the early 1970s. Actually, for almost all industries the minimum number of firms occurred during 1966-1978.

## TABLE 4.1: INDUSTRY DATA DESCRIPTIVE STATISTICS

Panel A: Firm Count By Industry

| | Full Sample | | | Sub-sample Averages | | |
|---|---|---|---|---|---|---|
| Industry | Average | Min | Max | 1966-1978 | 1979-1990 | 1991-2002 |
| Engineering & Machinery | 122.19 | 58 | 162 | 120.38 | 148.00 | 98.33 |
| Chemicals | 39.19 | 16 | 53 | 39.38 | 46.92 | 31.25 |
| Support | 74.57 | 23 | 134 | 41.77 | 75.92 | 108.75 |
| Electrical Eq. | 62.86 | 24 | 120 | 44.15 | 90.08 | 55.92 |
| Auto & Parts | 36.03 | 16 | 45 | 32.92 | 42.58 | 32.83 |
| General Retailers | 71.54 | 34 | 93 | 57.23 | 80.17 | 78.42 |
| Construction & Building | 99.46 | 38 | 134 | 79.23 | 114.08 | 106.75 |
| Beverages | 16.51 | 11 | 20 | 17.23 | 17.92 | 14.33 |
| Media & Entertainment | 72.00 | 22 | 110 | 42.85 | 78.67 | 96.92 |
| Aerospace & Defence | 14.81 | 8 | 21 | 11.77 | 16.58 | 16.33 |
| Food Producers | 54.41 | 17 | 72 | 48.77 | 66.25 | 48.67 |
| Leisure & Hotels | 68.24 | 18 | 109 | 41.85 | 71.67 | 93.42 |
| Other Goods | 61.08 | 9 | 162 | 20.46 | 48.92 | 117.25 |
| Oil & Gas | 23.62 | 8 | 37 | 11.38 | 29.33 | 31.17 |
| Other Services | 53.24 | 14 | 110 | 26.69 | 42.17 | 93.08 |
| Pharmaceuticals & Biotech | 11.65 | 5 | 27 | 5.77 | 8.75 | 20.92 |

Panel B: Market Capitalisation of Whole Industry

| | Full Sample | | | Sub-sample Averages | | |
|---|---|---|---|---|---|---|
| Industry | Average | Min | Max | 1966-1978 | 1979-1990 | 1991-2002 |
| Engineering & Machinery | 17,416 | 3,943 | 42,009 | 10,129 | 16,454 | 26,272 |
| Chemicals | 27,935 | 10,849 | 51,190 | 29,629 | 27,653 | 26,382 |
| Support | 15,822 | 1,688 | 51,715 | 4,169 | 10,483 | 33,786 |
| Electrical Eq. | 10,561 | 2,812 | 21,739 | 6,171 | 15,298 | 10,579 |
| Auto & Parts | 7,947 | 2,091 | 15,591 | 7,270 | 7,777 | 8,850 |
| General Retailers | 30,770 | 6,370 | 70,629 | 16,301 | 25,040 | 52,176 |
| Construction & Building | 23,554 | 3,917 | 53,851 | 10,102 | 25,874 | 35,807 |
| Beverages | 15,948 | 3,672 | 39,691 | 8,425 | 9,560 | 30,485 |
| Media & Entertainment | 28,758 | 2,156 | 124,397 | 5,626 | 15,860 | 66,716 |
| Aerospace & Defence | 6,553 | 414 | 22,920 | 1,278 | 4,542 | 14,280 |
| Food Producers | 25,640 | 5,116 | 49,666 | 12,187 | 23,663 | 42,190 |
| Leisure & Hotels | 16,703 | 2,597 | 40,047 | 6,014 | 15,154 | 29,833 |
| Other Goods | 54,440 | 9,434 | 162,176 | 17,602 | 30,671 | 118,115 |
| Oil & Gas | 66,158 | 10,182 | 204,663 | 29,891 | 47,063 | 124,541 |
| Other Services | 76,959 | 3,907 | 422,511 | 8,230 | 48,142 | 180,234 |
| Pharmaceuticals & Biotech | 45,379 | 3,462 | 195,478 | 8,167 | 22,082 | 108,988 |

Note: All values in panel B are in £'s millions

Panel B of Table 4.1 shows descriptive statistics for the real market capitalisation of industries in 2002 £'s millions. There is also substantive variation both across industry and across time in market capitalisation. The inclusion of the 'other services' and 'other goods' industries appears warranted given that the full-sample average market capitalisation for these industries are the highest of all industries and combined is a substantial proportion of the entire market. Furthermore the inclusion of Pharmaceuticals as a separate industry also appears warranted given that it is far from the smallest industry by average market capitalisation, or by any other indicator in Panel B. In fact even during the 1966-1978 period when there were very few Pharmaceuticals companies the market capitalisation of these was higher than 5 other industries suggesting an economically important role for this industry despite the low number of listed firms.

Annually rebalanced value-weighted price, earnings-price, dividend-price, earnings and dividends were then calculated for all industries. Each firm must have been trading for at least four quarters to be included in the sample for the next year. For each industry we set the price index equal to 100 in 1965, movements in the index are then calculated according to the value-weighted capital gain for that industry in each subsequent year. The weight attributed to each firm is based on the previous year end market capitalisation as a proportion of the relevant industry total capitalisation.

$$\begin{aligned} P_t &= P_{t-1}(1+\Delta P_t) \\ \Delta P_t &= \sum_{i=1}^{N} \Delta P_{i,t}.MV_{i,t-1} \Big/ MV_{t-1} \end{aligned} \tag{28}$$

$$\begin{aligned} Y_t/P_t &= \sum_{i=1}^{N} Y_{i,t}/P_{i,t}.MV_{i,t-1} \Big/ MV_{t-1}\,; \quad & D_t/P_t &= \sum_{i=1}^{N} D_{i,t}/P_{i,t}.MV_{i,t-1} \Big/ MV_{t-1} \\ Y_t &= P_t.Y_t/P_t & D_t &= P_t.D_t/P_t \end{aligned} \tag{29}$$

UK data on the consumer price index and three-month treasury bill rate were gathered from the IMF's International Financial Statistics database. Consumption data on individual series for non-durables and for services were taken from the UK Office for National Statistics (ONS) and these series were combined to form our measure of consumer expenditure. We examine the data in real terms throughout since we believe economic agents are primarily concerned about the purchasing power of their income, although our methodology is equally applicable to nominal values.

### 4.2.2 RETURN AND EQUITY PREMIA ESTIMATING EQUATIONS

We follow the approach of Fama and French (2002) to derive estimates of average stock returns and expected returns implied by fundamentals[36]. The historical average model states the average stock return ($R_t$) is simply equal to the average dividend yield ($D_t$ / $P_{t-1}$) plus the average growth of prices ($GP_t$).

$$A(R_t) = A(D_t/P_{t-1}) + A(GP_t) \tag{30}$$

Equation 4.3 shows the average return model, where *A ( )* is the arithmetic average, $D_t$ is real dividend payments during the current time period t, $P_{t-1}$ is the price index at the previous time period t-1 and $D_t$ / $P_{t-1}$ is the dividend yield. $GP_t$[37] is the proportional capital gain between time t-1 and t.

If the earnings-price ratio ($Y_t$ / $P_t$) has a constant mean then over extended periods of time the proportional change in prices must be matched by an almost

[36] See Chapter 3.2 for a fuller description of the Fama-French (2002) approach.

[37] $GP_t = (P_t - P_{t-1})/P_{t-1}$

equivalent proportional change in earnings. Since a constant mean is one condition that stationary variables must satisfy, it follows that if we have a stationary earnings-price series then earnings growth will give us an estimate of the expected growth of the share price. Consequently, the Fama-French Earnings Growth Model (31) obtains estimates from fundamentals of expected capital gains. It is defined as the return of earnings growth model *($RY_t$)* equals by the average dividend yield ($D_t / P_{t-1}$) plus the average earnings growth rate ($GY_t$)[38].

$$A\,(RY_t) = A\,(D_t \;/\; P_{t-1}) + A\,(GY_t) \tag{31}$$

Similar intuition applies to any other variable that is in a long-term stable relationship with prices. Another suitable candidate variable is dividends, which has the attraction of having been linked to firm valuation since at least Gordon's (1962) seminal dividend growth model. In this case the proportional capital gain of (30) can simply be replaced by average dividend growth rate. Therefore, and as outlined in more detail in Chapter 3.2.1 of this thesis, the Fama-French dividend growth model can be written as:

$$A\,(RD_t) = A\,(D_t \;/\; P_{t-1}) + A\,(GD_t) \tag{32}$$

As alluded to in the introduction of this chapter there are reasons to suppose that dividend growth may well understate the actual level of expected returns. Firstly, dividend payments are paid at the discretion of corporate executives and thus can be

[38] $GY_t = (Y_t - Y_{t-1}) / Y_{t-1}$

smoothed and managed as desired. In contrast earnings are based on figures that are independently audited. (Longstaff and Piazzesi, (2004))

Secondly, dividend payments can be affected by changes in corporate payout policy. US corporate payout policy has changed considerably over recent years. There has been a sharp decline in the proportion of firms that pay dividends at all (Fama and French, 2001), which has been coupled with a sharp increase in the popularity of share repurchases as an alternative and more tax-efficient means of distributing funds to equityholders (Grullon and Michaely, 2002). Firms outside the US have been slower to adopt share repurchases as an alternative means of distributing funds to shareholders. In the UK share repurchases were illegal until the 1980s, however, since 1995 share repurchases have grown in importance in the UK (Oswald and Young, (2004a, 2004b)) reaching £8bn by 2000, more than 20% of aggregate dividends.

Consequently, using dividends to estimate equity premia would understate the expected value in the UK, but the impact would be substantially greater in the US. This could be overcome if reliable share repurchase information were readily available, unfortunately they are not. Some of these difficulties can be avoided if earnings are instead used to estimate fundamental growth since these are unaffected by changes in corporate payout policy. Therefore earnings growth estimates provide a useful alternative indicator of the expected premium.

Nevertheless there are a also drawbacks with using earnings. Firstly, earnings don't by themselves guarantee any future payment to investors. Secondly, earnings can be manipulated and managed by managers without any direct relationship to operating performance (see e.g. Healy and Wahlen, 1999 for a review.) A particular concern is incidences of earnings management appear to have increased over time, especially during the latter part of our sample (Berenson, 2004). This could potentially lead to recent earnings growth being inflated and thus somewhat overstate true operating performance. In this chapter, we therefore report both dividend and earnings measures of the equity premium.

The Fama-French (2002) approach benefits from its generality and its simplicity. It relies upon very few underlying assumptions. The main assumption made is that the ratio of earnings to price is stationary. In fact, these fundamentals should provide us with a more precise estimate of the expected equity return due to earnings fluctuating less erratically than stock price indices. Furthermore since prices are affected by changes in expected returns whereas fundamentals should be relatively impervious to such a change the case can be made that fundamentals offer a better approximation than historical returns. Nevertheless, if the valuation ratios are the same at the sample beginning and end then the average equity premium yielded by each method will be almost identical.

### 4.2.3 PANEL REGRESSION METHOD

In our panel data regressions we focus upon the use of fixed effects within groups estimation, which since we have a balanced panel provide identical estimates to those provided by the least squares dummy variable method (LSDV). Individual industries have very different mean values of our predictor variables, especially the payout ratio. For example, one would expect the valuation and payout ratios to be high in mature industries such as food retailers, but lower in growing industries such as pharmaceuticals. However, we are not concerned about uncovering cross-sectional variation in mean earnings growth or returns across industries. Rather, we are concerned about time-series predictability of earnings growth or returns, but since there is substantial cross-sectional variation in industry payouts and fundamental valuations then it would be extremely restrictive to model the data on the basis that all industries tend to revert to the same payout ratio. Hence it is natural to use within groups estimators which de-mean the predictor variables and so consider the payout ratio for industry i at time t relative to the sample mean payout ratio for industry i.

An important issue with regards to the standard error estimation is the likelihood that errors are correlated across industries, for instance due to a common macroeconomic shock impacting upon all industries at the same time. In order to correct for such spatial correlation we use the method proposed by Driscoll and Kraay (1998), which corrects not only for spatial correlation but also for heteroscedasticity and serial correlation. Driscoll and Kraay corrected standard errors have good power properties for panels in which T > N. This is appropriate for our purposes since we have a time dimension (T) of 32 or more observations and a cross-sectional dimension of 16 industries (N).

### 4.2.4 STRUCTURAL BREAK TESTS

If there is a change in mean of a valuation ratio then this could imply that there has been a shift in expected return. Recent US empirical evidence supports such shifts (Carlson et al. (2002), Lettau and Van Nieuwerburgh (2006)). Carlson et al. (2002) use quarterly data to identify mean breaks in US aggregate price-earnings and dividend-price ratios. We follow their approach and report results from quarterly data.

We use structural break tests to identify if such regime shifts are apparent in the mean of the UK dividend-price and earnings-price ratios. In the simplest case of a single break illustrated by (33) then the mean of the earnings-price ratio equals $\delta^1$ prior to the breakpoint (at time *m*) and equals $\delta^2$ from period *m+1* onwards.

$$Y_t/P_t = \delta^1{}_t + \varepsilon_t; \; t = 1,\dots,m, \qquad (33)$$
$$Y_t/P_t = \delta^2{}_t + \varepsilon_t, \; t = m+1,\dots,T,$$

In Chapter 3 we used the Andrews-Quandt method to test for the presence of a single break. In Chapter 4 and 5 we use state-of-the-art methods that allow for the possibility of multiple breaks[39]. In Chapters 4 and 5 we test for structural breaks using the recently developed procedure of Bai and Perron ((1998), (2003)). Firstly, the Bai-Perron test assumes that the break date is unknown, selecting the breakpoint(s) that minimises the sum of squared residuals for the whole period. This test has the particularly attractive feature however is that it allows for the more complex cases where there are multiple regimes as given by (34).

$$Y_t/P_t = \delta^j{}_t + \varepsilon_t, \; t = T_{j\text{-}1} + 1, \; \dots \;, \; T_j \qquad (34)$$

for j=1,...,m+1, where $\delta^j$ is the regression coefficient for the *j*th regime. The *m*-partition ($T_1,\dots,T_m$), represents the breakpoints for the different regimes (by convention, $T_1$ = 0 and $T_{m+1}$ = T). Estimates of the regression coefficients are produced in order that the sum of squared residuals is minimised. Therefore for

[39] As noted in Chapter 3 even tests that allow for multiple structural breaks failed to detect more than a single break in the data series examined there. Hence we simply reported results from the Andrews-Quandt tests in Chapter 3.

however number of breaks is specified the position of the breaks is determined according to the minimum sum of squares. However, since the sum of squares will always fall or at the very least remain the same if the number of breaks is increased then separate tests were developed by Bai and Perron in order to distinguish the appropriate number of breaks for the series.

Bai and Perron (1998) develop a $SupF_T$ testing procedure which tests the null hypothesis of no structural breaks against the alternative of m structural breaks. A maximum F-test is produced which can they be used to assess if the null hypothesis of no structural break can be rejected. Bai and Perron (1998) also develop what they refer to as the $SupF_T(l+1|l)$ statistic to test the null hypothesis of l breaks against the alternative hypothesis of 1+l breaks. It begins with the global minimized sum of squared residuals for a model with l breaks. Each of the intervals defined by the l breaks is then analyzed for an additional structural break. From all of the intervals, the partition allowing for an additional break that results in the largest reduction in the sum of squared residuals is treated as the model with 1+l breaks. The statistic is used to test whether the additional break leads to a significant reduction in the sum of squared residuals.

However, there is an alternative approach to distinguish the appropriate number of structural breaks. This uses the information criteria approach of the various models to determine how many breaks. It has been suggested in the literature that the Scharwz Bayesian Information Criterion (BIC) could be the most appropriate to be used since it penalises the inclusion of additional variables most heavily relative to other established measures such as the Akaike Information Criterion (AIC). In this chapter we also use a modified Bayesian Information Criterion (BIC) developed by Liu et al. (1997), which Perron (1997) simulations indicate perform better in distinguishing the number of structural breaks when there is autocorrelation in the error terms than the standard BIC. Consequently, we also report the number of breaks implied by the Liu et al. modified BIC as means of a check that the number of breaks selected by the $SupF_T$ tests show a large degree of consistency[40].

### 4.2.5 UNIT ROOT TESTS

Stationarity, in so much as the relevant valuation ratios having a constant mean is a central issue for our dividend growth and earnings growth models, as outlined in Chapter 4.2.5. These models are based upon the assumption that the ratio of fundamental to price having a constant mean in order for dividend growth or earnings growth to give accurate estimates of the capital gain of the share index. Although, Fama and French (2002) forcefully assert that their method is robust to reasonable forms of non-stationarity. More generally, stationarity is an important issue since it is a pre-requisite for OLS regression analysis to be reliably conducted. These points are further elaborated on in Chapter 3.2.5.

For our industry compiled data, we find in Panel A of Table 4.2 that the dividend-price ratios of all industries are stationary for the full sample period, indicating that dividend growth will provide us with suitable estimates of capital gains. This picture is maintained when we look at industry earnings-price ratios. Table 4.2 Panel B illustrates that all industry earnings-price ratios are also stationary.

[40] ** BIC overstates number of breaks in series with high autocorrelation need to do SupF tests. Results reported for Minspan=30 (20% of data), Maxbreaks=4. 1965:4-2002:4

## TABLE 4.2: UK INDUSTRY UNIT ROOT TESTS ON ANNUAL DATA (1966-2002)

Panel A: Augmented Dickey Fuller Tests on Dividend-price ratio and Constant

$$\Delta(D_t/P_t)=\mu+\omega^*(D_{t-1}/P_{t-1})+\sum_{p=1}^{P}\omega_p\Delta(D_{t-p}/P_{t-p})+\varepsilon_t$$

| Industry | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| Oil & Gas | ADF (0) | -3.40 | -2.96 | Reject ho | Stationary |
| Chemicals | ADF (0) | -4.50 | -2.96 | Reject ho | Stationary |
| Construction & Building | ADF (0) | -4.64 | -2.96 | Reject ho | Stationary |
| Aerospace & Defence | ADF (0) | -3.53 | -2.96 | Reject ho | Stationary |
| Electrical Eq. | ADF (0) | -3.25 | -2.96 | Reject ho | Stationary |
| Engineering & Machinery | ADF (0) | -3.58 | -2.96 | Reject ho | Stationary |
| Beverages | ADF (0) | -2.98 | -2.96 | Reject ho | Stationary |
| Food Producers | ADF (0) | -3.92 | -2.96 | Reject ho | Stationary |
| Pharmaceuticals & Biotech | ADF (0) | -3.20 | -2.96 | Reject ho | Stationary |
| General Retailers | ADF (0) | -4.42 | -2.96 | Reject ho | Stationary |
| Leisure & Hotels | ADF (0) | -3.88 | -2.96 | Reject ho | Stationary |
| Media & Entertainment | ADF (0) | -3.02 | -2.96 | Reject ho | Stationary |
| Support | ADF (0) | -3.12 | -2.96 | Reject ho | Stationary |
| Auto & Parts | ADF (0) | -3.64 | -2.96 | Reject ho | Stationary |
| Other Goods | ADF (0) | -3.35 | -2.96 | Reject ho | Stationary |
| Other Services | ADF (0) | -3.38 | -2.96 | Reject ho | Stationary |

Panel B: Augmented Dickey Fuller Tests on Earnings-price ratio and Constant

$$\Delta(Y_t/P_t)=\mu+\omega^*(Y_{t-1}/P_{t-1})+\sum_{p=1}^{P}\omega_p\Delta(Y_{t-p}/P_{t-p})+\varepsilon_t$$

| Industry | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| Oil & Gas | ADF(0) | -4.87 | -2.96 | Reject ho | Stationary |
| Chemicals | ADF(0) | -4.19 | -2.96 | Reject ho | Stationary |
| Construction & Building | ADF(0) | -3.86 | -2.96 | Reject ho | Stationary |
| Aerospace & Defence | ADF(0) | -3.47 | -2.96 | Reject ho | Stationary |
| Electrical Equipment | ADF(0) | -3.87 | -2.96 | Reject ho | Stationary |
| Engineering & Machinery | ADF(0) | -3.56 | -2.96 | Reject ho | Stationary |
| Beverages | ADF(0) | -4.56 | -2.96 | Reject ho | Stationary |
| Food Producers | ADF(0) | -4.02 | -2.96 | Reject ho | Stationary |
| Pharmaceuticals & Biotech | ADF(0) | -3.71 | -2.96 | Reject ho | Stationary |
| General Retailers | ADF(0) | -4.24 | -2.96 | Reject ho | Stationary |
| Leisure & Hotels | ADF(0) | -3.73 | -2.96 | Reject ho | Stationary |
| Media & Entertainment | ADF(0) | -3.44 | -2.96 | Reject ho | Stationary |
| Support | ADF(0) | -3.40 | -2.96 | Reject ho | Stationary |
| Auto & Parts | ADF(0) | -3.51 | -2.96 | Reject ho | Stationary |
| Other Goods | ADF(0) | -3.28 | -2.96 | Reject ho | Stationary |
| Other Services | ADF(0) | -2.98 | -2.96 | Reject ho | Stationary |

## 4.3 INDUSTRY EQUITY PREMIA ESTIMATES

Table 4.3 and Table 4.4 provide annualised sample averages of pertinent variables to this study. Firstly, Table 4.3 reports that inflation with an average of 7.03% was relatively high over 1966-2002, whereas, the real risk-free rate averaged a more modest 1.97%. Further, Table 4.3 shows there is substantial variation across industries in dividend yield and earnings-price ratios. Industries that have developed and grown over the sample period such as Pharmaceuticals and Other Services (which includes IT) have the lowest earnings-price ratios and dividend yields, whereas more mature industries such as Engineering & Machinery and Chemicals are amongst those with the highest earnings-price ratios and dividend yields. There is also variation in the payout ratio (the ratio of dividends to earnings) across industries ranging from 50.97% for the Automobile industry to 71.06% for Chemicals. However, there appears no obvious trend underlying the cross-sectional patterns in payout ratios. This is somewhat surprising growing industries might also be expected to have low payout ratios since they will tend to use earnings more for investment than paying dividends.

Table 4.4 reports estimates of the key metrics of the study especially the average return, earnings growth and dividend growth model estimates of equity returns (calculated using (30), (31) and (32)) and equity premia. Figure 4.1 illustrates graphically the substantial variation apparent in the equity premium across the 16 UK industries we examine over our sample period 1966-2002. Equity premia from average historical returns ($RX_t$) vary greatly across industries from around 5% p.a. in the Chemicals and Engineering and Machinery industries to more than 13% p.a. in the Pharmaceuticals and Biotech industry. We interpret this as simply being compensation for the higher level of risk borne by those investing in sectors that yield higher expected returns; Gebhardt et al. (2001) provide some empirical support for US industries that this is the case for the prospective equity premium.

We also find similar variation in equity premia estimates from our earnings growth and dividend growth estimates models. The fundamental equity premia estimates ($RXY_t$ and $RXD_t$) have a clear and reasonably strong, positive relationship with those from average returns. Hence there is a considerable degree of agreement across models over which industries have relatively low actual and expected equity premia and those which have relatively higher equity premia. Since, dividend yield is a common component to all three models, this suggests that the high capital gains generated by the pharmaceutical and food retailing industries relative to other industries is to a large due to strong earnings growth and strong dividend growth in these industries during the sample period. This indicates that in industries where there was strong in-sample growth of earnings and dividends investors in those industries tended to receive relatively high levels of capital appreciation.

There are however differences between the different model estimates of equity premia for individual industries. In general, both the earnings growth and dividend growth models imply that the expected equity premium was below realised historical average equity premium. Figure 4.2A, illustrates that in 13 industries out of 16 average returns exceeded those implied by the earnings growth model. However, the magnitude of the difference varies across industries. In 4 of these 13 industries the estimates were within 1% p.a. of each other. The remaining 9 industries, a majority of the total, have earnings growth that was substantially in economic terms below capital gains. Nevertheless there were 3 industries – Chemicals, Automotive and Oil and Gas – where the expected equity premia was above the historical premia.

## TABLE 4.3: ESTIMATES OF FUNDAMENTAL GROWTH AND VALUATION RATIOS

| | | $Inf_t$ | $F_t$ | $D_t/P_{t-1}$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Panel A: Market Data | | | | | | | | | | |
| VW Market | 1966-2002 | 7.03% | 1.97% | 4.82% | 4.33% | 7.61% | 59.97% | 2.89% | 4.57% | 6.55% |
| EW Market | 1966-2002 | 7.03% | 1.97% | 4.75% | 4.39% | 7.58% | 59.68% | 2.45% | 4.49% | 5.15% |
| Panel B: Industry Data | | | | | | | | | | |
| Engineering & Machinery | 1966-2002 | 7.03% | 1.97% | 5.86% | 5.59% | 8.58% | 67.19% | -1.53% | -0.11% | 1.12% |
| Chemicals | 1966-2002 | 7.03% | 1.97% | 5.47% | 5.22% | 8.05% | 71.06% | -1.61% | 4.03% | 1.68% |
| Support | 1966-2002 | 7.03% | 1.97% | 4.88% | 4.52% | 7.65% | 59.22% | -0.19% | 1.26% | 2.85% |
| Electrical Eq. | 1966-2002 | 7.03% | 1.97% | 4.04% | 3.78% | 7.47% | 52.16% | 0.28% | 1.87% | 3.74% |
| Auto & Parts | 1966-2002 | 7.03% | 1.97% | 4.71% | 4.51% | 7.34% | 50.97% | 5.01% | 8.75% | 3.57% |
| General Retailers | 1966-2002 | 7.03% | 1.97% | 4.16% | 3.84% | 6.24% | 62.03% | 2.08% | 3.51% | 4.45% |
| Construction & Building | 1966-2002 | 7.03% | 1.97% | 5.27% | 4.93% | 8.68% | 59.89% | 0.85% | 3.35% | 3.67% |
| Beverages | 1966-2002 | 7.03% | 1.97% | 5.14% | 4.74% | 7.11% | 66.29% | 1.14% | 3.40% | 4.37% |
| Media & Entertainment | 1966-2002 | 7.03% | 1.97% | 4.54% | 4.18% | 7.28% | 57.51% | -0.13% | 1.65% | 5.41% |
| Aerospace & Defence | 1966-2002 | 7.03% | 1.97% | 4.91% | 4.63% | 8.07% | 58.40% | 1.40% | 4.49% | 5.09% |
| Food Producers | 1966-2002 | 7.03% | 1.97% | 4.75% | 4.33% | 7.93% | 55.37% | 1.53% | 3.39% | 5.60% |
| Leisure & Hotels | 1966-2002 | 7.03% | 1.97% | 4.73% | 4.27% | 7.22% | 62.10% | 13.15% | 6.18% | 6.75% |
| Other Goods | 1966-2002 | 7.03% | 1.97% | 5.53% | 4.99% | 9.04% | 56.65% | 4.01% | 3.58% | 6.29% |
| Oil & Gas | 1966-2002 | 7.03% | 1.97% | 5.25% | 4.74% | 9.17% | 65.54% | 2.60% | 13.67% | 7.04% |
| Other Services | 1966-2002 | 7.03% | 1.97% | 3.42% | 3.03% | 6.19% | 51.65% | 3.33% | 5.07% | 8.92% |
| Pharmaceuticals & Biotech | 1966-2002 | 7.03% | 1.97% | 3.42% | 2.96% | 5.23% | 58.81% | 7.25% | 7.69% | 11.83% |

## TABLE 4.4: ESTIMATES OF EQUITY RETURNS AND EQUITY PREMIA

| | | $RD_t$ | $RY_t$ | $R_t$ | $RXD_t$ | $RXY_t$ | $RX_t$ | $RX_t - RXD_t$ | $RX_t - RXY_t$ |
|---|---|---|---|---|---|---|---|---|---|
| Panel A: Market Data | | | | | | | | | |
| VW Market | 1966-2002 | 7.71% | 9.39% | 11.36% | 5.75% | 7.42% | 9.40% | 3.65% | 1.98% |
| EW Market | 1966-2002 | 7.20% | 9.24% | 9.90% | 5.24% | 7.28% | 7.94% | 2.70% | 0.66% |
| Panel B: Industry Data | | | | | | | | | |
| Engineering & Machinery | 1966-2002 | 4.33% | 5.75% | 6.98% | 2.36% | 3.78% | 5.01% | 2.65% | 1.23% |
| Chemicals | 1966-2002 | 3.86% | 9.50% | 7.15% | 1.89% | 7.54% | 5.18% | 3.29% | -2.35% |
| Support | 1966-2002 | 4.69% | 6.13% | 7.73% | 2.72% | 4.17% | 5.76% | 3.04% | 1.59% |
| Electrical Eq. | 1966-2002 | 4.32% | 5.91% | 7.78% | 2.36% | 3.95% | 5.82% | 3.46% | 1.87% |
| Auto & Parts | 1966-2002 | 9.72% | 13.47% | 8.28% | 7.75% | 11.50% | 6.32% | -1.44% | -5.19% |
| General Retailers | 1966-2002 | 6.24% | 7.66% | 8.60% | 4.27% | 5.70% | 6.64% | 2.36% | 0.94% |
| Construction & Building | 1966-2002 | 6.12% | 8.62% | 8.94% | 4.15% | 6.65% | 6.98% | 2.83% | 0.32% |
| Beverages | 1966-2002 | 6.29% | 8.55% | 9.52% | 4.32% | 6.58% | 7.55% | 3.23% | 0.97% |
| Media & Entertainment | 1966-2002 | 4.41% | 6.19% | 9.95% | 2.45% | 4.22% | 7.99% | 5.54% | 3.76% |
| Aerospace & Defence | 1966-2002 | 6.31% | 9.40% | 10.00% | 4.35% | 7.44% | 8.03% | 3.68% | 0.60% |
| Food Producers | 1966-2002 | 6.28% | 8.14% | 10.35% | 4.31% | 6.18% | 8.38% | 4.07% | 2.20% |
| Leisure & Hotels | 1966-2002 | 17.87% | 10.90% | 11.48% | 15.91% | 8.94% | 9.51% | -6.39% | 0.57% |
| Other Goods | 1966-2002 | 9.54% | 9.11% | 11.82% | 7.57% | 7.15% | 9.85% | 2.28% | 2.71% |
| Oil & Gas | 1966-2002 | 7.84% | 18.92% | 12.28% | 5.88% | 16.95% | 10.32% | 4.44% | -6.64% |
| Other Services | 1966-2002 | 6.76% | 8.49% | 12.34% | 4.79% | 6.53% | 10.38% | 5.59% | 3.85% |
| Pharmaceuticals & Biotech | 1966-2002 | 10.67% | 11.11% | 15.25% | 8.70% | 9.15% | 13.28% | 4.58% | 4.14% |

**FIGURE 4.1: EQUITY PREMIA ESTIMATES**

Figure 4.1A: Historical Average Model

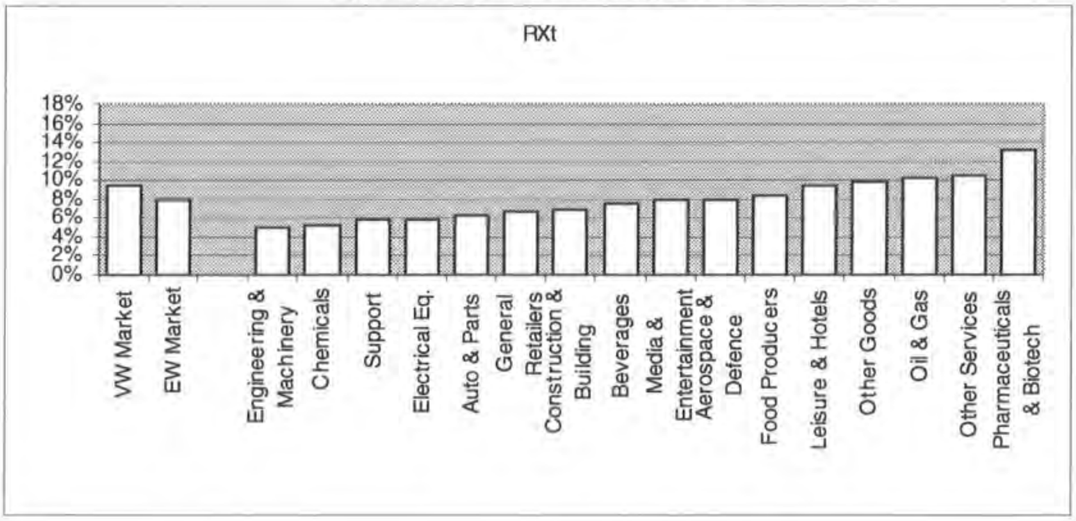



Figure 4.1B: Earnings Growth Model

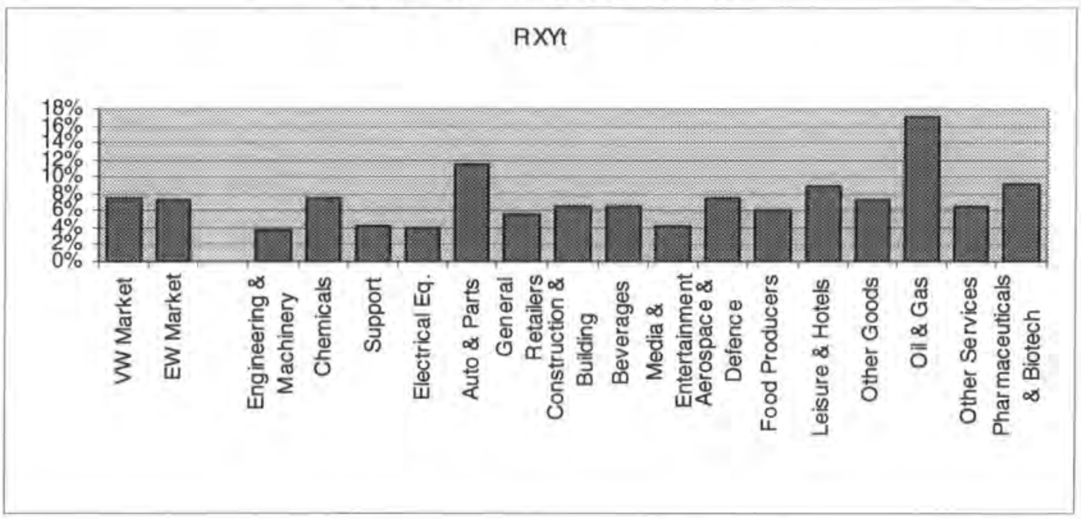



Figure 4.1C: Dividend Growth Model

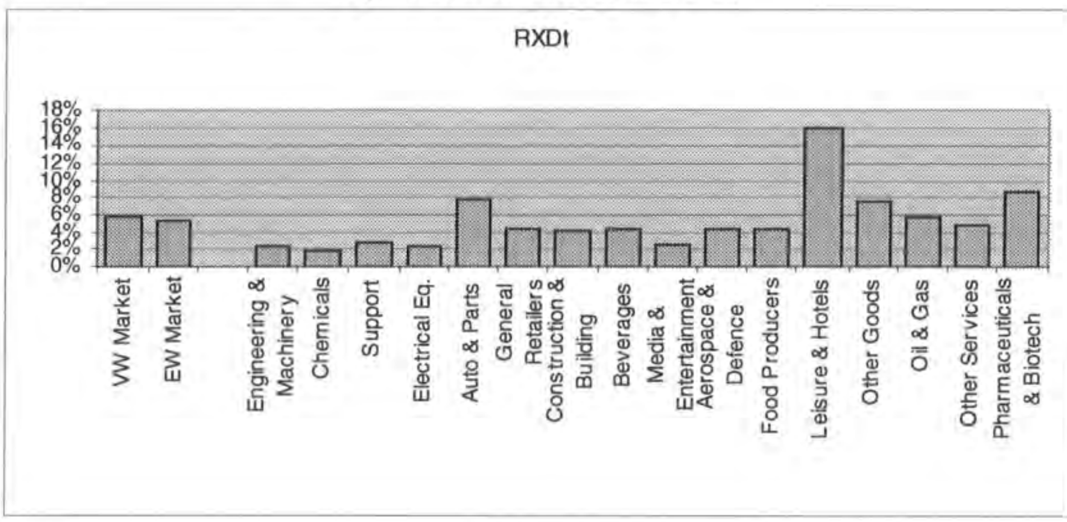


Figure 4.2A: Deviation of Actual Return from that implied by Earnings Growth

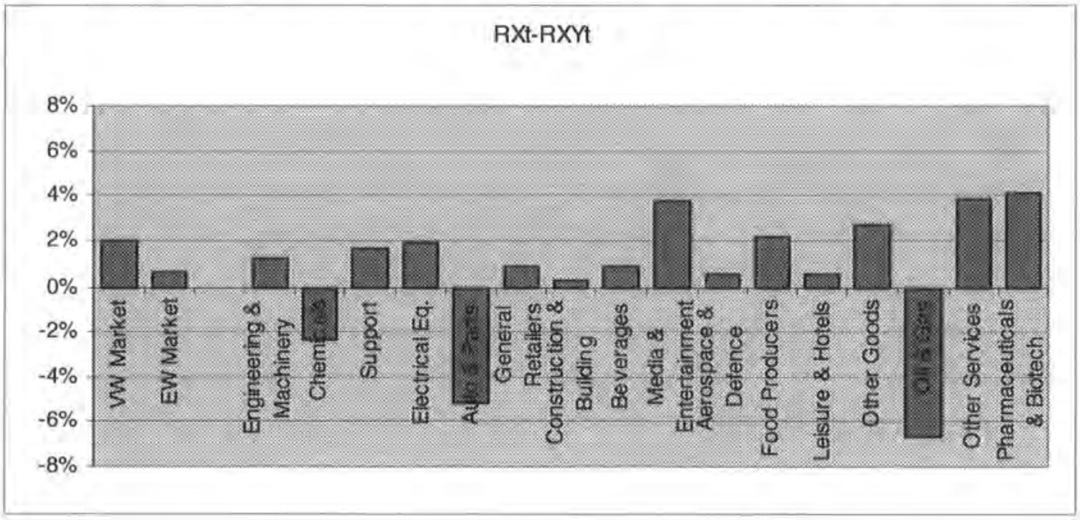
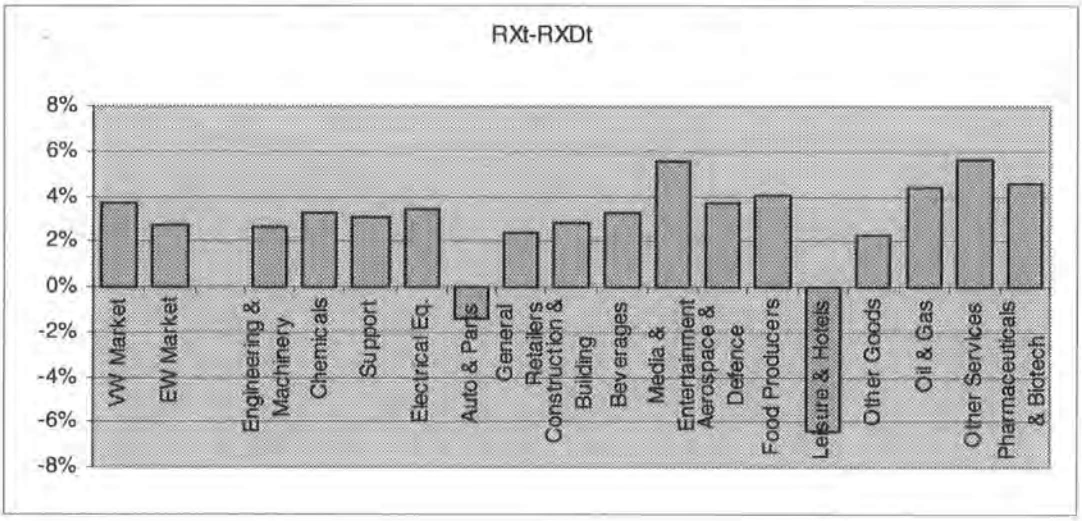



Figure 4.2B: Deviation of Actual Return from that implied by Dividend Growth




The results from the dividend growth model suggest that the expected equity premium tended to be even further below the historical premia than suggested by the earnings growth method. In 14 of 16 industries dividend growth implied premia were below the historical average; in all 14 of these industries the discrepancy between the estimates was at least 2% p.a. and in 5 it was in excess of 4% p.a. Only in the cases of the Automotive and Leisure and Hotels industries did earnings implied equity premia surpass the historic premia. Therefore, overall there seems to be consistent evidence in favour of the hypothesis that historical returns exceeded those implied by fundamentals from these initial results.

An issue with using the arithmetic average is that its value can be inflated by an outlying value. This is important for our capital gain estimates since there was a stock market crash in 1974 which reversed over the next year[41]. Simply averaging the individual values for 1974 and 1975 leads to a severely distorted estimated of the net price change between 1973-1975. We adjust the outlying values in 1974 and 1975 for capital gains and earnings growth by taking the net change from 1973-1975 and attributing half of this to each of 1974 and 1975 as shown by (35).[42]

$$\begin{aligned} GP_{1974} &= GP_{1975} = \frac{P_{1975}/P_{1973}-1}{2} \\ GY_{1974} &= GY_{1975} = \frac{Y_{1975}/Y_{1973}-1}{2} \\ GD_{1974} &= GD_{1975} = \frac{D_{1975}/D_{1973}-1}{2} \end{aligned} \tag{35}$$

As demonstrated by table 4.5, the discrepancy between these different methods of calculating average capital gains for just the two years of 1974-1975 are extremely large. In all industries the arithmetic average is much larger than the adjusted average and the difference is at least 20% in 13 of the 16 industries. This translates into the outlying event of the stock market crash of 1974 being able to account for more than 1%, and in some substantially more than 1%, of the annualised average capital gain over the entire sample period for these 13 industries. Even for the

[41] Dimson, Marsh and Staunton (2002) note the UK stock market crash of 1974 was one of the most severe market crashes of the 20th Century.
[42] Naturally, adjustment using the geometric average for 1973-1975 yields qualitatively identical results to those using the adjustment proposed here.

industry which seems least affected by the shock, Other Goods, it still causes an over-estimation of the annual capital gain of 0.8%.

However, both adjusted and unadjusted methods yield broadly similar estimates for earnings growth and dividend growth over 1973-1975. Particularly any divergence between the two methods becomes rather miniscule once it is averaged over the entire sample period. There is just one exception to this general point, the earnings growth estimate of the Oil and Gas industry is sensitive to the market crash of 1974. This doesn't seem unusual since the Oil and Gas industry operations would be most affected by the OPEC Oil Crisis, which is suggested was largely responsible for the market turbulence of 1974-1975.

Does this bias in the estimate of the capital gain account for most of the divergence between equity premium estimates?

Figure 4.3A demonstrates that after accounting for the impact of the 1974 stock market crash in 9 of the 16 industries average return and earnings growth equity premium estimates are similar. However, there are 4 industries in which average return estimates still substantially exceed the earnings growth estimates, namely, Other Goods, Other Services, Pharmaceuticals and Biotech and Media and Entertainment. Conversely 3 industries have average return estimates substantially below those implied by earnings growth: Automobiles, Oil and Gas and Chemicals. However, it is important to note that once the 1974 outlier is corrected for then there is no systematic pattern in the divergences between earnings growth and historical return estimates, specifically there is no recurring tendency for the historical average return to exceed the earnings growth estimate. This is important since it is contrary to the US aggregate results of Fama and French (2002) who interpreted there finding of a substantial difference in historical and expected equity premia as an overall decline in expected returns. Our results question that there was in fact a systematic decline in expected returns since no systematic tendency for historical returns to exceed the earnings growth return is apparent in our sample. Are these findings mirrored for the dividend growth method?

The dividend growth model results conflict with those for the earnings growth model. Figure 4.3B illustrates that the dividend method still generally produces equity premia estimates that are below those of historical average even after the 1974 stock market crash is adjusted for. Although the scale of the disparities between the dividend growth and historical premia is smaller when the 1974 outlier is removed, a sizeable discrepancy still remains for almost all industries. A positive difference between the equity premia estimates remains in 14 of the 16 industries, and of these 14 the smallest divergence is 0.96% and in fact for 11 of the 14 industries the discrepancy exceeds 1.50%. A margin of greater than 1.50% is large and will be analysed carefully in the proceeding sections of this chapter in order for an appropriate explanation for this discrepancy to be found.

Our results stimulate vital questions as to the driving forces behind these findings. What is it about Pharmaceutical or Entertainment industry that has caused their capital gains to exceed their fundamental growth and why has Automotive industry fundamental growth been greater than their capital gains? Perhaps, most important of all, why do we not find that historical returns have exceeded the earnings model across the board? Fama and French (2002) concluded low future expected returns seemed to be the main factor causing realised returns to be above that implied by fundamentals at the market level. Our analysis of UK industries according to the dividend growth estimates of equity premia suggests that these have been below the historical average, as for the US aggregate market.

## TABLE 4.5 ADJUSTING FOR THE 1974 STOCK MARKET CRASH

Panel A: Capital Gains Adjustment

| Market | 1974 GPt | 1975 GPt | Av of GPt 1974 & 1975 | Net Change 1973-1975 | Difference 1974-1975 | Difference 1966-2002 |
|---|---|---|---|---|---|---|
| EW Market | -59.07% | 86.30% | 13.62% | -11.87% | -25.49% | -1.38% |
| VW Market | -58.80% | 94.36% | 17.78% | -9.97% | -27.74% | -1.50% |
| **Industry** | | | | | | |
| Engineering & Machinery | -56.00% | 86.70% | 15.35% | -8.93% | -24.28% | -1.31% |
| Chemicals | -55.56% | 96.56% | 20.50% | -6.32% | -26.82% | -1.45% |
| Support | -58.20% | 81.82% | 11.81% | -12.00% | -23.81% | -1.29% |
| Electrical Eq. | -63.85% | 77.41% | 6.78% | -17.93% | -24.71% | -1.34% |
| Auto & Parts | -62.96% | 101.92% | 19.48% | -12.60% | -32.08% | -1.73% |
| Construction & Building | -61.72% | 111.49% | 24.88% | -9.52% | -34.40% | -1.86% |
| General Retailers | -62.94% | 75.69% | 6.37% | -17.45% | -23.82% | -1.29% |
| Aerospace & Defence | -60.32% | 117.14% | 28.41% | -6.92% | -35.33% | -1.91% |
| Beverages | -60.08% | 60.93% | 0.43% | -17.88% | -18.30% | -0.99% |
| Media & Entertainment | -66.27% | 78.46% | 6.10% | -19.90% | -26.00% | -1.41% |
| Food Producers | -58.89% | 109.23% | 25.17% | -7.00% | -32.16% | -1.74% |
| Leisure & Hotels | -64.63% | 56.35% | -4.14% | -22.35% | -18.21% | -0.98% |
| Other Goods | -47.69% | 62.36% | 7.34% | -7.53% | -14.87% | -0.80% |
| Oil & Gas | -60.67% | 126.45% | 32.89% | -5.46% | -38.36% | -2.07% |
| Other Services | -64.14% | 99.62% | 17.74% | -14.21% | -31.95% | -1.73% |
| Pharmaceuticals & Biotech | -59.27% | 105.23% | 22.98% | -8.20% | -31.18% | -1.69% |

Panel B: Earnings Growth Adjustment

| Market | 1974 GYt | 1975 GYt | Av of GYt 1974 & 1975 | Av Net Change 1974-1975 | Difference 1974-1975 | Difference 1966-2002 |
|---|---|---|---|---|---|---|
| EW Market | 5.23% | -24.61% | -9.69% | -10.33% | -0.64% | -0.03% |
| VW Market | 23.20% | -38.29% | -7.55% | -11.99% | -4.44% | -0.24% |
| **Industry** | | | | | | |
| Engineering & Machinery | 11.81% | -12.75% | -0.47% | -1.22% | -0.75% | -0.04% |
| Chemicals | 19.29% | -39.20% | -9.95% | -13.73% | -3.78% | -0.20% |
| Support | -0.61% | -25.25% | -12.93% | -12.86% | 0.08% | 0.00% |
| Electrical Eq. | 9.93% | -25.24% | -7.65% | -8.91% | -1.25% | -0.07% |
| Auto & Parts | -33.43% | -16.35% | -24.89% | -22.16% | 2.73% | 0.15% |
| Construction & Building | -22.30% | -25.87% | -24.09% | -21.20% | 2.88% | 0.16% |
| General Retailers | -20.58% | -16.20% | -18.39% | -16.72% | 1.67% | 0.09% |
| Aerospace & Defence | -4.23% | -22.12% | -13.17% | -12.70% | 0.47% | 0.03% |
| Beverages | -10.52% | -30.72% | -20.62% | -19.00% | 1.62% | 0.09% |
| Media & Entertainment | -4.25% | -34.64% | -19.44% | -18.71% | 0.74% | 0.04% |
| Food Producers | -7.27% | -27.39% | -17.33% | -16.33% | 1.00% | 0.05% |
| Leisure & Hotels | -25.69% | -21.57% | -23.63% | -20.86% | 2.77% | 0.15% |
| Other Goods | 24.13% | -19.92% | 2.11% | -0.29% | -2.40% | -0.13% |
| Oil & Gas | 136.49% | -68.06% | 34.21% | -12.23% | -46.44% | -2.51% |
| Other Services | -18.20% | 10.33% | -3.93% | -4.87% | -0.94% | -0.05% |
| Pharmaceuticals & Biotech | 6.92% | -9.87% | -1.47% | -1.81% | -0.34% | -0.02% |

Panel C: Dividend Growth Adjustment

| Market | 1974 GDt | 1975 GDt | Av of GDt 1974 & 1975 | Av Net Change 1974-1975 | Difference 1974-1975 | Difference 1966-2002 |
|---|---|---|---|---|---|---|
| EW Market | -4.99% | -10.53% | -7.76% | -7.50% | 0.26% | 0.01% |
| VW Market | -2.13% | -13.57% | -7.85% | -7.71% | 0.14% | 0.01% |
| **Industry** | | | | | | |
| Engineering & Machinery | -1.77% | -10.00% | -5.88% | -5.80% | 0.09% | 0.00% |
| Chemicals | 12.17% | -28.20% | -8.01% | -9.73% | -1.72% | -0.09% |
| Support | 5.91% | -13.67% | -3.88% | -4.28% | -0.40% | -0.02% |
| Electrical Eq. | -7.73% | 4.76% | -1.48% | -1.67% | -0.18% | -0.01% |
| Auto & Parts | -23.93% | -27.76% | -25.84% | -22.52% | 3.32% | 0.18% |
| Construction & Building | -12.00% | -2.72% | -7.36% | -7.20% | 0.16% | 0.01% |
| General Retailers | -6.48% | -6.95% | -6.71% | -6.49% | 0.23% | 0.01% |
| Aerospace & Defence | -3.56% | -16.68% | -10.12% | -9.82% | 0.30% | 0.02% |
| Beverages | -6.92% | -10.75% | -8.83% | -8.46% | 0.37% | 0.02% |
| Media & Entertainment | -5.46% | -11.05% | -8.26% | -7.95% | 0.30% | 0.02% |
| Food Producers | -1.19% | -11.78% | -6.48% | -6.41% | 0.07% | 0.00% |
| Leisure & Hotels | -6.48% | -15.99% | -11.23% | -10.72% | 0.52% | 0.03% |
| Other Goods | 5.73% | -17.10% | -5.68% | -6.18% | -0.49% | -0.03% |
| Oil & Gas | -5.84% | -10.75% | -8.30% | -7.98% | 0.31% | 0.02% |
| Other Services | -12.51% | -2.21% | -7.36% | -7.22% | 0.14% | 0.01% |
| Pharmaceuticals & Biotech | -8.58% | -4.32% | -6.45% | -6.26% | 0.19% | 0.01% |

Panel D: Overall Impact

| Market | Unadj. RXt-RXYt | Adj RXt - RXYt | Unadj. RXt-RXDt | Adj RXt - RXDt |
|---|---|---|---|---|
| EW Market | 0.69% | -0.65% | 3.65% | 1.52% |
| VW Market | 2.00% | 0.72% | 2.70% | 2.15% |
| **Industry** | | | | |
| Engineering & Machinery | 1.23% | -0.04% | 2.65% | 1.33% |
| Chemicals | -2.35% | -3.60% | 3.29% | 1.94% |
| Support | 1.59% | 0.30% | 3.04% | 1.78% |
| Electrical Eq. | 1.87% | 0.60% | 3.46% | 2.13% |
| Auto & Parts | -5.19% | -7.07% | -1.44% | -3.35% |
| Construction & Building | 0.32% | -1.69% | 2.36% | 0.96% |
| General Retailers | 0.94% | -0.44% | 2.83% | 1.06% |
| Aerospace & Defence | 0.60% | -1.34% | 3.23% | 1.76% |
| Beverages | 0.97% | -0.11% | 5.54% | 2.22% |
| Media & Entertainment | 3.76% | 2.32% | 3.68% | 4.12% |
| Food Producers | 2.20% | 0.41% | 4.07% | 2.32% |
| Leisure & Hotels | -7.30% | -0.56% | -6.39% | -7.41% |
| Other Goods | 2.71% | 2.03% | 2.28% | 1.50% |
| Oil & Gas | -6.64% | -6.20% | 4.44% | 2.35% |
| Other Services | 3.85% | 2.17% | 5.59% | 3.85% |
| Pharmaceuticals & Biotech | 4.14% | 2.47% | 4.58% | 2.89% |

Notes: Panel A illustrates the impact of the 1974 stock market crash on our average estimate of capital gains. Such a crash and rebound can result in a large upward bias in the estimate growth rate over the period. The first two columns show the capital gains for 1974 and 1975 respectively. Unadj. $GP_t$ simply takes the average of these two figures $(GP_{1974}+GP_{1975})/2$. Adj. $GP_t$ uses the correction suggested in Section 4.3 and given by equation (35), $(P_{1975}/P_{1973}-1)/2$ this takes the overall change in the price level from 1973-1975 and attributes half of the gain to 1974 and the other half to 1975. Difference 1974-1975 is Adj. $GP_t$ – Unadj. $GP_t$ and shows the extent to which taking the simple average for 1974-1975 is distorted. Difference 1966-2002 is 2/37*Difference 1974-1975 and gives the extent to which the overall sample average is distorted by the 1974 stock market crash. Panel B illustrates the impact of the 1974 stock market upon estimates of earnings growth. Unadj. $RX_t$-$RXY_t$ is simply the same figure as given for $RX_t$-$RXY_t$ in Table 2 interpreted as the difference between equity premia estimates. The final column is Unadj. $RX_t$-$RXY_t$ - $GP_t$ Difference 1966-2002 + $GY_t$ Difference 1966-2002 and gives the difference between equity premia estimates after the 1974 stock market crash has been neutralised.

Figure 4.3A: Deviation of Actual Return from that implied by Earnings Growth corrected for 1974 spike in earnings-price ratios

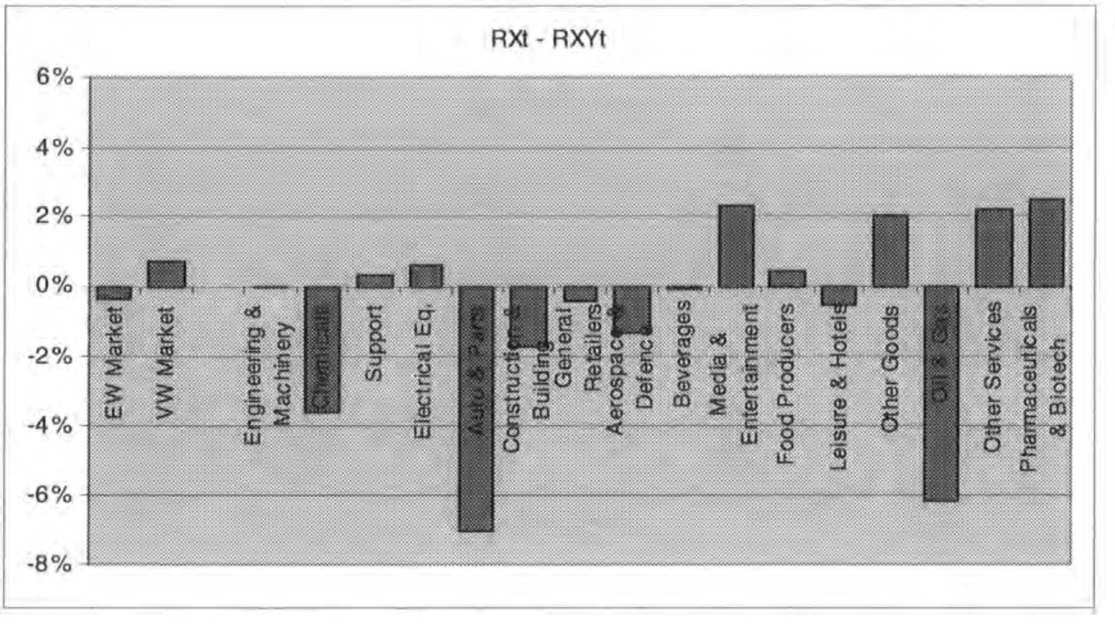
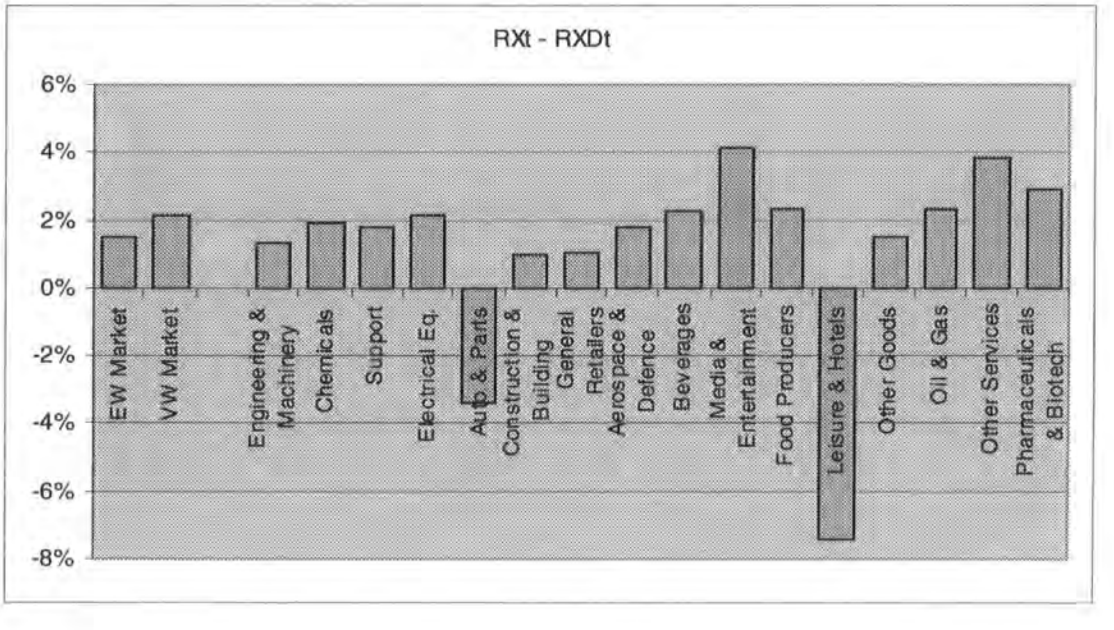



Figure 4.3B: Deviation of Actual Return from that implied by Dividend Growth corrected for 1974 spike in dividend-price ratios



Nevertheless, we find in several specific industries there was a divergence between equity premia estimates. It is of interest to examine the source of the inconsistencies between the dividend and earnings models. Furthermore, where there is any discrepancy between the results at the industry level then we are able to investigate the likely cause. From this perspective, the remaining industries provide a useful control group since there are no substantial discrepancies between their premia estimates. The obvious framework to examine this within is the present value model of Campbell and Shiller (1988). Campbell's (1991) return decomposition demonstrates if actual returns were above (below) expectations this can be caused by either: a) the expected future growth of fundamentals being unusually high (low) or b) a decline (rise) in expected unconditional stock returns during the sample period. Chapter 4.4 addresses these issues.

## 4.4 EXPLAINING UK EQUITY RETURNS

### 4.4.1 ARE POST 2000 EXPECTED DIVIDEND AND EARNINGS GROWTH RATES HIGH?

It has been argued we have entered a new economic era, which has enabled higher rates of economic growth to be attained. One claim is that the ever increasing pace of technological developments has facilitated more rapid productivity growth (Jagannathan et al, 2001). An alternative argument is that increasing globalisation as witnessed by growing moves towards a truly globally integrated economic system in which resources can be allocated more efficiently due to previous barriers being removed and in which companies are able to locate production internationally in order to minimise costs. A final assertion is that substantial declines in inflation during the latter part of the 20th Century in many developed economies has set the footing for more stable and higher economic growth in the future,[43] economic policymakers have argued. These three factors have lead to hopes that higher levels of economic growth can be achieved and sustained long into the future.

However, if this higher future expected growth rate had not been anticipated at the beginning of our sample period then this would lead to unexpected capital gains being realised by investors as the potential for extended periods of high economic growth became known to investors and incorporated into their expectations.

In this chapter we focus on the predictability of fundamental growth. This is because the predictability of market fundamental growth is covered in depth in Chapter 3.4.2. Given that the market equity premium results reported in this chapter and similar to those reported in Chapter 3 then a re-assessment of market fundamental growth appears unwarranted. However, we haven't previously examined the predictability of industry fundamental growth and hence we concentrate on this area in the following section.

We examine all the variables available at industry level, which we believe could plausibly predict future fundamental growth rates. We use: i) the fundamental-price ratio, ii) the dividend-payout ratio, iii) prior growth of fundamentals and iv) the consumption-fundamental ratio. These variables have been found to predict fundamentals at the market level. Campbell and Shiller (1998) find the ratio of

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[43] However, Modigliani and Cohn (1979) argue that inflation causes money illusion amongst investors who discount cashflows using too low a discount rate during periods of high inflation and vice-versa; if this is true (Ritter and Warr, 2002 provide some empirical support for this hypothesis) investors are irrational.

fundamental-price predicts fundamental growth albeit with the wrong sign and there is an extensive literature documenting the predictive power of the dividend-price ratio over returns dating back to Campbell and Shiller (1988) and Fama and French (1988). The dividend-payout ratio has been found to predict earnings growth by Arnott and Asness (2003) for the US and to also predict dividend growth by Ap Gwilym et al. (2006) in their study of 7 developed countries including the UK. Arnott and Asness (2003) and Ap Gwilym et al. (2006) also find a role for lagged fundamental growth for predicting future fundamental growth. Menzly, Santos and Veronesi (2004) provide a theoretical model and empirical results supporting a relationship between consumption-fundamental ratio and future fundamental growth. They specify dividends as their measure of fundamentals. We additionally use earnings as a measure of fundamentals and investigate if consumption-earnings ratio can predict future earnings growth, as well as if consumption-dividend ratio can predict future dividend growth.

However, to our knowledge, our study is the first to consider this issue for such a large number of industries data specifically using a panel data specification. As discussed in Chapter 4.2.3 we focus upon the use of fixed effects within groups estimation, which since we have a balanced panel provide identical estimates to those provided by the least squares dummy variable method (LSDV). This specification enables us to focus upon time-series predictability of earnings growth by modelling the regressand the payout ratio for industry i at time t relative to the sample mean payout ratio for industry i rather than relative to average mean payout ratio of all industries. Imposing the later assumption would be very restrictive since it implies all industries have the same mean payout ratio, whilst our data indicates in many cases that individual industries have very different mean values of our predictor variables.

Consequently, we use within groups estimators which de-mean the predictor variables and so consider the payout ratio for industry i at time t relative to the sample mean payout ratio for industry i. We use the Driscoll and Kraay (1998) estimator for the covariance matrix which is consistent for spatial dependence, serial correlation and heteroscedasticity.

$$\begin{aligned} GY_{i,t} &= \alpha_i + \beta_1.(Y_{i,t-1}/P_{i,t-1}) + \beta_2.(D_{i,t-1}/Y_{i,t-1}) + \beta_3.GY_{i,t-1} + \beta_4.CYDT_{i,t-1} + \varepsilon_{i,t} \\ GY5_{i,t} &= \alpha_i + \beta_1.(Y_{i,t-1}/P_{i,t-1}) + \beta_2.(D_{i,t-1}/Y_{i,t-1}) + \beta_3.GY5_{i,t-5} + \beta_4.CYDT_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{36}$$

Table 4.5 reports the results of regression (36). Although, we are primarily concerned with medium to long term growth prospects of the industries, rather than the short-term, we report results for the one-year horizon as well as a five-year prediction window. We expect the coefficient on the valuation ratio should be negative. When earnings (or dividends) are high relative to prices then one would expect earnings growth to be low, so that the earning-price ratio will revert towards its mean; for this to occur $\beta$ must be negative. Similarly one would expect mean reversion in the relationship between consumption and earnings and hence the sign on this coefficient should be positive.

The theoretical supposition is that both dividend and earnings growth should be negatively related to the payout ratio. Firms with low payout ratios retain a large portion of their earnings. Since retained earnings for most companies are the primary source of investment funds this suggests firms with low dividend payouts should be investing heavily feeding higher future earnings and higher dividend payments also.

## TABLE 4.6: FUNDAMENTAL GROWTH PREDICTABILITY

Panel A: One-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Industries (N) | Panel Observations | Panel $D_{t-1}/Y_{t-1}$ | Panel $Y_{t-1}/P_{t-1}$ | Panel $GY_{t-1}$ | Panel $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|---|
| Panel GYt | 1967-2002 | 16 | 576 | 0.42<br>(3.07) | | | | 0.0742 |
| Panel GYt | 1967-2002 | 16 | 576 | | -2.35<br>(4.05) | | | 0.1327 |
| Panel GYt | 1967-2002 | 16 | 576 | | | -0.04<br>(0.47) | | 0.0016 |
| Panel GYt | 1967-2002 | 16 | 576 | 0.21<br>(1.37) | -1.95<br>(3.76) | | | 0.1472 |
| Panel GYt | 1967-2002 | 16 | 576 | 0.50<br>(3.51) | | 0.11<br>(1.29) | | 0.0822 |
| Panel GYt | 1967-2002 | 16 | 576 | 0.29<br>(1.80) | -1.93<br>(3.89) | 0.10<br>(1.20) | | 0.1537 |
| Panel GYt | 1967-2002 | 16 | 576 | | | | 0.04<br>(5.75) | 0.1183 |
| Panel GYt | 1967-2002 | 16 | 576 | 0.01<br>(0.10) | -1.98<br>(4.27) | 0.08<br>(0.95) | 0.04<br>(3.96) | 0.2045 |
| Panel GYt | 1967-2002 | 16 | 576 | | -1.93<br>(4.29) | | 0.04<br>(4.99) | 0.2020 |

Panel B: Five-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Industries (N) | Panel Observations | Panel $D_{t-1}/Y_{t-1}$ | Panel $Y_{t-1}/P_{t-1}$ | Panel $GY5_{t-5}$ | Panel $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|---|
| Panel GY5t | 1967-1998 | 16 | 512 | 0.38<br>(4.84) | | | | 0.2523 |
| Panel GY5t | 1967-1998 | 16 | 512 | | -1.02<br>(2.20) | | | 0.0904 |
| Panel GY5t | 1971-1998 | 16 | 448 | | | -0.40<br>(2.78) | | 0.1266 |
| Panel GY5t | 1967-1998 | 16 | 512 | 0.34<br>(4.11) | -0.40<br>(1.40) | | | 0.2656 |
| Panel GY5t | 1971-1998 | 16 | 448 | 0.36<br>(4.06) | | -0.16<br>(1.28) | | 0.3041 |
| Panel GY5t | 1971-1998 | 16 | 448 | 0.32<br>(3.33) | -0.37<br>(1.12) | -0.16<br>(1.30) | | 0.3163 |
| Panel GY5t | 1967-1998 | 16 | 512 | | | | 0.04<br>(8.98) | 0.5156 |
| Panel GY5t | 1971-1998 | 16 | 448 | 0.04<br>(0.37) | -0.42<br>(1.58) | -0.09<br>(0.89) | 0.04<br>(5.23) | 0.5697 |
| Panel GY5t | 1971-1998 | 16 | 448 | | -0.50<br>(2.03) | | 0.04<br>(8.09) | 0.5469 |

Panel C: One-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Industries (N) | Panel Observations | Panel $D_{t-1}/Y_{t-1}$ | Panel $D_{t-1}/P_{t-1}$ | Panel $GD_{t-1}$ | Panel $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|---|
| Panel GDt | 1967-2002 | 16 | 576 | -0.42<br>(2.71) | | | | 0.0857 |
| Panel GDt | 1967-2002 | 16 | 576 | | -3.81<br>(3.15) | | | 0.0596 |
| Panel GDt | 1967-2002 | 16 | 576 | | | -0.11<br>(0.76) | | 0.0113 |
| Panel GDt | 1967-2002 | 16 | 576 | -0.41<br>(2.82) | -3.61<br>(4.46) | | | 0.1376 |
| Panel GDt | 1967-2002 | 16 | 576 | -0.44<br>(2.70) | | -0.13<br>(0.91) | | 0.1019 |
| Panel GDt | 1967-2002 | 16 | 576 | -0.43<br>(2.83) | -3.62<br>(4.60) | -0.13<br>(0.94) | | 0.1542 |
| Panel GDt | 1967-2002 | 16 | 576 | | | | 0.04<br>(2.27) | 0.1568 |
| Panel GDt | 1967-2002 | 16 | 576 | -0.37<br>(3.21) | -2.87<br>(5.56) | -0.06<br>(0.61) | 0.04<br>(2.34) | 0.2520 |
| Panel GDt | 1967-2002 | 16 | 576 | -0.36<br>(3.43) | -2.83<br>(5.91) | | 0.04<br>(2.21) | 0.2496 |

Panel D: Five-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Industries (N) | Panel Observations | Panel $D_{t-1}/Y_{t-1}$ | Panel $D_{t-1}/P_{t-1}$ | Panel $GD5_{t-5}$ | Panel $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|---|
| Panel GD5t | 1967-1998 | 16 | 512 | -0.11<br>(1.57) | | | | 0.0381 |
| Panel GD5t | 1967-1998 | 16 | 512 | | -1.19<br>(1.51) | | | 0.0388 |
| Panel GD5t | 1971-1998 | 16 | 448 | | | -0.12<br>(1.95) | | 0.0204 |
| Panel GD5t | 1967-1998 | 16 | 512 | -0.11<br>(1.54) | -1.16<br>(1.81) | | | 0.0737 |
| Panel GD5t | 1971-1998 | 16 | 448 | -0.06<br>(1.18) | | -0.12<br>(1.76) | | 0.0317 |
| Panel GD5t | 1971-1998 | 16 | 448 | -0.05<br>(1.22) | -1.06<br>(1.63) | -0.12<br>(1.93) | | 0.0735 |
| Panel GD5t | 1967-1998 | 16 | 512 | | | | 0.03<br>(6.43) | 0.5136 |
| Panel GD5t | 1971-1998 | 16 | 448 | -0.05<br>(2.47) | -0.51<br>(1.49) | 0.11<br>(2.02) | 0.03<br>(17.03) | 0.5792 |
| Panel GD5t | 1971-1998 | 16 | 448 | -0.05<br>(2.54) | | 0.11<br>(1.99) | 0.03<br>(15.45) | 0.5703 |

Notes to Table 4.6: $D_{t-1}$ / $Y_{t-1}$ is the payout ratio for t-1,$Y_{t-1}$ / $P_{t-1}$ is the earnings price ratio also for t-1. $GY_t$ is real earnings growth for period t, defined as: $(Y_t / Y_{t-1})$-1. $GY5_t$ is real five-year average earnings growth, defined as: $((Y_{t+4} / Y_{t-1})-1)/5$. $CYDT_{t-1}$ is the industry time detrended ratio of non-durable and service consumption-industry earnings. The regressions are estimated using fixed effects, therefore each observation is de-meaned relative to the industry average. Industry subscripts for each variable have been dropped to aid clarity. Values in parentheses are absolute t-values calculated using the Driscoll and Kraay (1998) correction for spatial dependence, serial correlation and heteroscedasticity.

The persistence of earnings is likely to be dependent upon the horizon looked at. For short-term earnings it is likely there will be positive correlation between observations. However, over longer time horizons it is likely there will be a negative relationship since earnings tend to mean-revert over longer horizons. Dividend growth would be expected to be positively correlated, especially at short horizons since managers tend to adjust gradually towards a target payout ratio (Lintner (1956)).

Panel A of Table 4.6 demonstrates that in bivariate regressions consumption-earnings ratio explains more of the variation in one-year earnings growth than the other variables individually. The multivariate regressions indicate that consumption-earnings dominates the payout ratio which becomes insignificant if both are included in the predictive regression. Current earnings growth appears of limited usefulness for predicting future earnings growth since it is statistically insignificant in all regression specifications. However, the earnings-price ratio and consumption-earnings ratio appear to contain information incremental to each other. In a regression including both variables they are both significant and the adjusted goodness-of-fit, of 20.20% is only fractionally below that including all four variables.

Table 4.6 Panel B indicates that as much as 56.97% of five-year average earnings growth can be captured by (36). Consumption-earnings is positively related to future earnings growth as expected. The earnings-price and lagged earnings growth ratio are negatively related to future earnings growth as expected. The payout ratio is statistically significantly and positively related with earnings growth, which is contrary to conventional wisdom but consistent with prior studies conducted at the market level. All variables are statistically significant in bivariate regressions, however the consumption-earnings ratio appears to be the most important, explaining more than half (50%) five-year earnings growth variability alone. Again the consumption-earnings ratio appears to dominate the payout ratio. As at the one-year horizon, once consumption-earnings is included in the regression payout ratio becomes insignificant. Our preferred model includes just the earnings-price ratio and consumption-earnings. Parameter estimates of these coefficients appear quite stable across different regression specifications. The more parsimonious specification finds both variables are statistically significant and has only a marginal reduction in adjusted R-squared to 54.69% from 56.97%[44].

Panel C of Table 4.6 demonstrates that in bivariate regressions consumption-dividend ratio explains more of the variation in one-year dividend growth than the other variables individually. The regressions also indicate that lagged dividend growth is not significantly related to future dividend growth in either the bivariate or multivariate regressions. However, the multivariate regressions indicate that the consumption-dividend ratio, payout ratio and dividend-price ratio are all of importance and incremental value for the predictive regression. In a regression including these three variables they are both significant and the adjusted goodness-of-fit, of 24.96%, only fractionally below the 25.20% if all four variables are included.

Table 4.6 Panel D indicates that as much as 57.03% of five-year average dividend growth can be captured by (36). Consumption-dividend is positively related to future dividend growth as expected. The dividend-price and lagged dividend growth ratio are negatively related to future dividend growth as expected. The payout ratio is also negatively related to future dividend growth, as suggested by conventional wisdom. Only the consumption-dividend ratio is statistically significant at the 5% level in bivariate regressions, which can explain more than half (50%) five-year dividend growth variability alone. However, lagged dividend growth is

[44] Use of the differing specifications for forecasting produces qualitatively identical results.

significant at the 10% level. Nevertheless, the payout ratio and lagged dividend growth become important conditional on the inclusion of the consumption-dividend ratio in the regression. The model including all variables has an adjusted R-squared of 57.92% which is only marginally more than the 57.03% of the model which includes just the consumption-dividend ratio, payout ratio and lagged dividend growth. Our preferred model is therefore the more parsimonious specification which includes just the payout ratio, dividend-price ratio and consumption-dividend ratio[45].

Therefore for forecasts at both horizons we use a model including earnings-price, lagged earnings and consumption-earnings in order to produce forecasts.

$$\begin{aligned} GY_{i,t+1} &= \alpha_i + \beta_1.(Y_{i,t}/P_{i,t}) + \beta_2.D_{i,t}/Y_{i,t} + \beta_3.GY_{i,t} + \beta_4.CYDT_{i,t} + \varepsilon_{i,t+1} \\ GY5_{i,t+1} &= \alpha_i + \beta_1.(Y_{i,t}/P_{i,t}) + \beta_2.D_{i,t}/Y_{i,t} + \beta_3.GY5_{i,t-4} + \beta_4.CYDT_{i,t} + \varepsilon_{i,t+1} \end{aligned} \tag{37}$$

We combine our regression coefficient estimates from (36) with values of the relevant variables for the last year of our sample in order to derive forecasts of future expectations of fundamental growth as shown by (37). Table 4.7 reports the predicted growth rates relative to the historical mean. We also report the average of the last 3 year growth rates from 2000-2002 to examine the consistency of these predictions.

Table 4.7 Panel A suggests that a change in expected future fundamental growth could help explain the equity premia discrepancies we found. For instance in industries where capital gains were lower than earnings growth substantially below mean future growth is predicted in the Automotive industry. Furthermore in the Aerospace and Construction industries where there was a more modest difference, below average growth is also forecast. In industries where capital gains exceeded earnings growth, substantially above mean growth is forecast for the media and

[45] Use of the differing specifications for forecasting produces qualitatively identical results.

pharmaceutical industries, two of the four where there was a substantial difference. However, for the oil and gas industry results are not consistent with their equity premia results being explained through changes in expected fundamental growth; one would expect substantially below mean future growth but in fact considerably above mean future growth is forecast.

For five-year earnings growth forecasts the results tend to be fairly similar to those reported for one-year earnings growth. Of the 7 industries where there was a substantial discrepancy in equity premia estimates only for the automotive, other services and media industries is long-term growth forecast to be consistent with a change in expected growth explanation of this result. For the other services and media (automotive) industry above (below) mean growth in earnings in forecast which would help explain why historical returns were higher (lower) than those implied by the earnings model. The results for the chemical and pharmaceutical industry suggest medium term growth is likely to be about average, perhaps slightly leaning towards a forecast which suggests fundamentals were responsible for a modest part of the equity premium results. Furthermore, several sectors where earnings growth and capital gains were approximately equal over 1966-2002 are forecast to have exceedingly high future earnings growth, specifically, the electricals, engineering, and support service industries. Therefore, we find mixed evidence that changes in expected future fundamental growth can explain the discrepancies arising from our equity premia results.[46]

[46] Alternative specifications of the forecasting model yielded qualitatively identical results.

# TABLE 4.7: FORECASTS OF FUNDAMENTAL GROWTH

Panel A: 1-year Earnings Growth Forecasts excluding Payout and Earnings growth

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Other Goods | 2.68% | 4.39% | Neutral | Neutral |
| Oil & Gas | 12.40% | 6.13% | Optimistic | Optimistic |
| Chemicals | -1.95% | -0.35% | Neutral | Neutral |
| Construction & Building | -11.29% | -7.27% | Pessimistic | Pessimistic |
| Aerospace & Defence | -12.98% | -6.47% | Pessimistic | Pessimistic |
| Electrical Eq. | 2.31% | -1.56% | Neutral | Neutral |
| Engineering & Machinery | 10.59% | 2.71% | Optimistic | Neutral |
| Beverages | -1.73% | 0.08% | Neutral | Neutral |
| Food Producers | 1.08% | 3.07% | Neutral | Neutral |
| Other Services | 3.28% | 8.96% | Neutral | Optimistic |
| Pharmaceuticals & Biotech | 0.24% | 1.84% | Neutral | Neutral |
| General Retailers | -3.68% | -2.34% | Neutral | Neutral |
| Leisure & Hotels | -2.06% | -0.68% | Neutral | Neutral |
| Media & Entertainment | 11.11% | 9.46% | Optimistic | Optimistic |
| Support | 3.68% | 4.69% | Neutral | Neutral |
| Auto & Parts | -30.47% | -9.51% | Pessimistic | Pessimistic |

Panel B: 5-year Earnings Growth Forecasts excluding Payout and Earnings Growth

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Other Goods | 0.53% | 1.22% | Neutral | Optimistic |
| Oil & Gas | 5.66% | 0.08% | Optimistic | Neutral |
| Chemicals | -1.19% | -0.87% | Pessimistic | Neutral |
| Construction & Building | -5.31% | -2.81% | Pessimistic | Pessimistic |
| Aerospace & Defence | -6.76% | -3.80% | Pessimistic | Pessimistic |
| Electrical Eq. | 8.16% | 2.66% | Optimistic | Optimistic |
| Engineering & Machinery | 14.55% | 5.79% | Optimistic | Optimistic |
| Beverages | -1.24% | -0.10% | Pessimistic | Neutral |
| Food Producers | 0.05% | 1.43% | Neutral | Optimistic |
| Other Services | 4.14% | 6.13% | Optimistic | Optimistic |
| Pharmaceuticals & Biotech | 0.76% | 1.10% | Neutral | Optimistic |
| General Retailers | -0.30% | 0.61% | Neutral | Neutral |
| Leisure & Hotels | -0.02% | 0.11% | Neutral | Neutral |
| Media & Entertainment | 8.15% | 5.24% | Optimistic | Optimistic |
| Support | 3.84% | 3.32% | Optimistic | Optimistic |
| Auto & Parts | -26.54% | -5.88% | Pessimistic | Pessimistic |

Notes: These forecasts are produced using the preferred regression model from Table 4.6, which uses the earnings-price ratio and the detrended consumption-industry earnings ratio to predict future earnings growth. In the table we report the value predicted at the end of our sample, 2002, and as a check of the consistency of this forecast we also report the average of the three forecasts from 2000-2002. A positive value indicates that the relevant fundamental growth rate is expected to be above average. A negative value indicates that the relevant fundamental growth rate is expected to be below average. An optimistic outlook is defined as if earnings growth is predicted to be more than 5% above average at one-year horizon or 1% p.a. above average at five-year horizon. Similarly a pessimistic outlook defined as if earnings growth is predicted to be more than 5% below average at one-year horizon of 1% p.a. below average at five-year horizon. Otherwise we refer to the forecast as being neutral.

## TABLE 4.7: (CONTINUED)

Panel C: 1-year Dividend Growth Forecasts excluding Dividend growth

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Other Goods | -7.39% | -1.52% | Pessimistic | Neutral |
| Oil & Gas | -8.81% | -3.14% | Pessimistic | Neutral |
| Chemicals | 3.59% | 4.03% | Neutral | Neutral |
| Construction & Building | 2.81% | 7.32% | Neutral | Optimistic |
| Aerospace & Defence | -7.60% | 2.27% | Pessimistic | Neutral |
| Electrical Eq. | 10.31% | 4.07% | Optimistic | Neutral |
| Engineering & Machinery | 15.95% | 5.03% | Optimistic | Optimistic |
| Beverages | 4.96% | 7.63% | Neutral | Optimistic |
| Food Producers | 7.26% | 7.29% | Optimistic | Optimistic |
| Other Services | 8.07% | 6.71% | Optimistic | Optimistic |
| Pharmaceuticals & Biotech | 1.17% | 3.14% | Neutral | Neutral |
| General Retailers | 3.32% | 6.96% | Neutral | Optimistic |
| Leisure & Hotels | -1.95% | 0.93% | Neutral | Neutral |
| Media & Entertainment | 10.15% | 11.93% | Optimistic | Optimistic |
| Support | 7.62% | 13.30% | Optimistic | Optimistic |
| Auto & Parts | -20.74% | -2.42% | Pessimistic | Neutral |

Panel D: 5-year Dividend Growth Forecasts excluding Dividend-price

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Other Goods | -0.93% | -0.59% | Neutral | Neutral |
| Oil & Gas | 0.14% | -2.32% | Neutral | Pessimistic |
| Chemicals | -0.47% | -0.53% | Neutral | Neutral |
| Construction & Building | -1.33% | -0.21% | Pessimistic | Neutral |
| Aerospace & Defence | -2.32% | -0.89% | Pessimistic | Neutral |
| Electrical Eq. | 6.16% | 2.71% | Optimistic | Optimistic |
| Engineering & Machinery | 10.27% | 4.15% | Optimistic | Optimistic |
| Beverages | -0.31% | 0.31% | Neutral | Neutral |
| Food Producers | -0.18% | 0.50% | Neutral | Neutral |
| Other Services | 1.73% | 1.94% | Optimistic | Optimistic |
| Pharmaceuticals & Biotech | 0.08% | 0.06% | Neutral | Neutral |
| General Retailers | 0.51% | 1.31% | Neutral | Optimistic |
| Leisure & Hotels | -1.11% | -1.12% | Pessimistic | Pessimistic |
| Media & Entertainment | 4.26% | 2.55% | Optimistic | Optimistic |
| Support | 2.76% | 2.57% | Optimistic | Optimistic |
| Auto & Parts | -16.58% | -2.97% | Pessimistic | Pessimistic |

Notes: These forecasts are produced using the preferred regression model from Table 4.6, which uses the earnings-price ratio and the detrended consumption-industry earnings ratio to predict future earnings growth. In the table we report the value predicted at the end of our sample, 2002, and as a check of the consistency of this forecast we also report the average of the three forecasts from 2000-2002. A positive value indicates that the relevant fundamental growth rate is expected to be above average. A negative value indicates that the relevant fundamental growth rate is expected to be below average. An optimistic outlook is defined as if earnings growth is predicted to be more than 5% above average at one-year horizon or 1% p.a. above average at five-year horizon. Similarly a pessimistic outlook defined as if earnings growth is predicted to be more than 5% below average at one-year horizon of 1% p.a. below average at five-year horizon. Otherwise we refer to the forecast as being neutral.

Table 4.7 Panel C provides limited support for the notion that a change in expected future fundamental growth could help explain the equity premia discrepancies uncovered in Chapter 4.3. In the two industries where dividend growth model estimates exceeded the historical average, Automotive and Leisure and Hotels, the only pessimistic forecast is for the Automotive industry in 2002, but even this is ameliorated if the prior two years are also considered. In the two industries where the historical return exceeded dividend growth estimates the most, Media and Entertainment and Other Services, then extremely large forecasts of dividend growth are consistently made for future years. This suggests that for the Media and Other Services groups that a change in expected future fundamental growth might have contributed to the equity premium results. However, for the remaining industries, the forecasts are mixed. One would expect future fundamental growth to be forecasted to be high across these industries to explain the equity premium results. This is given the fact that these indicated historical returns exceeded those implied by dividend growth across all these remaining 12 industries. However, the results are split with 3 pessimistic forecasts, 5 neutral forecasts and 4 optimistic forecasts for 2002.

For five-year dividend growth forecasts the results tend to be fairly similar to those reported for one-year dividend growth. Results are marginally more supportive of the hypothesis that expectations of future fundamental growth played a role in our equity premia results. For the two industries where dividend growth exceeded capital gains, Automotive and Leisure, then poor future dividend growth was forecast. For the two industries where capital gains exceeded dividend growth the most, Media and Other Services medium-term dividend growth is forecast to be above average. This suggests for these industries with the extreme results then future expectations of dividend growth can play a role in explaining their equity premia results. However, we would expect the remaining 12 industries to all have substantially above mean dividend growth to explain their equity premia results; this is the case for only 3 of them, while 2 others have very low dividend growth forecast. Overall there is limited evidence that high expected dividend growth can explain the equity premia results.

Therefore we find some evidence that changes in expectations of fundamental growth are able to shed some light on our equity premium results in specific instances. However, what is abundantly clear, according to our analysis conducted in this chapter, is that changes in expected fundamental growth rates alone are unable to explain the discrepancies between historical equity premia and those implied by fundamentals. Hence we next turn our attention to an alternative explanation; that these deviations were caused by a change in expected returns.[47]

### 4.4.2 WAS THERE ANY CHANGE IN UK EXPECTED STOCK RETURNS OVER 1966-2002?

The prior literature, based almost exclusively on studies of the US suggests that there has been a fall in expected returns over recent decades. Studies which attempt to identify the underlying economic causes of such a change in expected return identify the 1990s as the time when this shift occurred (Lettau et al. (2006), Bansal and Lundblad (2002)). This literature can be connected to a related literature which has studied structural breaks in valuation ratios via the present value framework. If there is a shift in the dividend-price (or earnings-price) ratio then this suggests that there has been a change in expected returns. This is given the perceived

[47] Alternative specifications of the forecasting model yielded qualitatively identical results.

wisdom that the dividend-price ratio fails to predict long-term future dividend growth. Previous studies have found a downward break in ratios of fundamental-price for the aggregate US (Carlson et al. (2002)) and UK (Vivian (2005)) markets during the 1990s. We investigate the nature and direction of any breaks in the earnings-price and dividend-price ratios for both the aggregate UK market and individual industry indices.

If expected returns have declined (risen) on average over time then a stream of unexpected capital gains (losses) may have been triggered causing realised historical returns to be substantially above (below) investors expectations. In these circumstances estimations of the equity premium implied by fundamentals, which are essentially unaffected by changes in expected returns, will give us estimates of the true *ex ante* risk premium that are not contaminated by unanticipated share price appreciation (depreciation).

We use the procedures developed by Bai and Perron ((1998), (2003)) to investigate the possibility of multiple regimes in UK earnings-price ratios. In order to determine the number of breaks in the series Bai and Perron (1998) advocate the use of the $SupF_T(1)$ test followed by sequential $SupF_T(l+1|l)$ tests to determine the appropriate number of breaks. However, they also acknowledge that Bayesian information criteria or modified Bayesian information criteria could be useful for determining the number of breaks. We report modified Bayesian information (LWZ) criterion of Liu et al. (1997), to help verify our results. However, we do note that as found by Perron (1997) that the LWZ criterion could over-estimate the number of breaks in the presence of autocorrelation, which regressions with our application to earnings-price ratios are highly prone to.

# TABLE 4.8: BAI-PERRON TESTS OF MULTIPLE STRUCTURAL BREAKS

Panel A: Bai-Perron Multiple Structural Break Tests of Industry Earnings-Price Ratios

| Sample 1965:4 2002:4 | SupFT(1) | SupFT(2) | SupFT(3) | SupF(2\|1) | SupF(3\|2) | No. of Breaks Selected Sequential | Modified Sequential | LWZ |
|---|---|---|---|---|---|---|---|---|
| VW Index | 3.02 | 16.73 | 26.03 | 2.76 | 16.29 | 0 | 3 | 3 |
| EW Index | 0.45 | 25.15 | 26.52 | 9.19 | 14.34 | 0 | 3 | 3 |
| Engineering & Machinery | 4.55 | 26.64 | 19.04 | 33.05 | 4.31 | 1 | 2 | 2 |
| Chemicals | 2.53 | 8.49 | 13.16 | 6.15 | 4.57 | 0 | 2 | 3 |
| Support | 0.64 | 10.51 | 11.00 | 10.78 | 6.07 | 0 | 2 | 3 |
| Electrical Eq. | 7.16 | 8.44 | 6.06 | 23.73 | 1.37 | 2 | 2 | 2 |
| Auto & Parts | 0.38 | 9.50 | 9.86 | 11.52 | 3.72 | 0 | 2 | 2 |
| General Retailers | 6.53 | 9.79 | 6.83 | 9.27 | 0.87 | 2 | 2 | 2 |
| Construction & Building | 4.76 | 17.29 | 11.04 | 30.55 | 0.14 | 2 | 2 | 2 |
| Beverages | 6.92 | 41.14 | 64.07 | 67.19 | 1.85 | 2 | 2 | 3 |
| Media & Entertainment | 1.48 | 18.09 | 26.12 | 14.09 | 17.12 | 0 | 3 | 3 |
| Aerospace & Defence | 1.06 | 4.31 | 2.90 | 8.02 | 0.65 | 0 | 0 | 2 |
| Food Producers | 1.03 | 14.27 | 18.30 | 14.02 | 14.02 | 0 | 3 | 3 |
| Leisure & Hotels | 3.06 | 25.20 | 17.85 | 6.57 | 4.02 | 0 | 2 | 2 |
| Other Goods | 1.30 | 31.34 | 33.09 | 11.68 | 18.02 | 0 | 3 | 3 |
| Oil & Gas | 1.33 | 8.40 | 7.18 | 14.62 | 3.17 | 0 | 2 | 2 |
| Other Services | 2.09 | 6.99 | 5.56 | 2.57 | 2.88 | 0 | 2 | 3 |
| Pharmaceuticals & Biotech | 1.85 | 14.02 | 14.45 | 3.86 | 1.24 | 0 | 2 | 3 |

Panel B: Bai-Perron Multiple Structural Break Tests of Industry Dividend-Price Ratios

| Sample 1965:4 2002:4 | SupFT(1) | SupFT(2) | SupFT(3) | SupF(2\|1) | SupF(3\|2) | No. of Breaks Selected Sequential | Modified Sequential | LWZ |
|---|---|---|---|---|---|---|---|---|
| VW Index | 9.45 | 23.72 | 18.45 | 3.56 | 6.10 | 1 | 1 | 3 |
| EW Index | 1.85 | 21.76 | 29.21 | 11.53 | 6.23 | 0 | 2 | 3 |
| Engineering & Machinery | 1.31 | 29.96 | 20.56 | 28.99 | 2.59 | 0 | 2 | 2 |
| Chemicals | 1.84 | 18.71 | 23.15 | 18.03 | 4.49 | 0 | 2 | 3 |
| Support | 3.20 | 6.47 | 19.75 | 7.41 | 6.81 | 0 | 2 | 3 |
| Electrical Eq. | 1.92 | 14.58 | 9.34 | 8.99 | 0.37 | 0 | 2 | 2 |
| Auto & Parts | 2.99 | 11.48 | 11.02 | 16.09 | 2.59 | 0 | 2 | 3 |
| General Retailers | 2.62 | 6.44 | 5.35 | 3.37 | 0.81 | 0 | 2 | 2 |
| Construction & Building | 8.44 | 19.66 | 14.39 | 12.09 | 0.92 | 2 | 2 | 2 |
| Beverages | 3.88 | 13.48 | 13.05 | 11.64 | 1.98 | 0 | 2 | 2 |
| Media & Entertainment | 17.42 | 8.68 | 27.86 | 1.67 | 6.50 | 1 | 1 | 3 |
| Aerospace & Defence | 2.21 | 2.42 | 2.99 | 0.55 | 0.31 | 0 | 0 | 3 |
| Food Producers | 3.51 | 23.94 | 23.92 | 9.83 | 5.40 | 0 | 2 | 2 |
| Leisure & Hotels | 6.08 | 9.28 | 7.46 | 9.08 | 1.68 | 2 | 2 | 2 |
| Other Goods | 1.58 | 21.86 | 28.55 | 7.64 | 2.85 | 2 | 2 | 2 |
| Oil & Gas | 6.68 | 8.21 | 10.70 | 5.41 | 0.00 | 1 | 1 | 3 |
| Other Services | 1.80 | 1.33 | 1.16 | 0.87 | 1.05 | 0 | 0 | 1 |
| Pharmaceuticals & Biotech | 2.77 | 1.75 | 2.81 | 2.07 | 1.75 | 0 | 0 | 2 |

Notes: The 10% critical values for $SupF_T(k)$ for k=1-3 are 4.37, 5.59, 6.72. The 10% critical values for $SupF_T(l+1|l)$ for l=1-2 are 6.72, 8.13. To choose the number of breaks the sequential procedure examines if $SupF_T(1)$ rejects the null of 0 breaks in favour of 1 and then proceeds to conduct $SupF_T(l+1|l)$, until it fails to reject the null. Given the nature of the data we find in many cases the $SupF_T(1)$ test fails to reject the null but the $SupF_T(2)$ and $SupF_T(3)$ tests do suggesting there are multiple rather than no structural breaks. We therefore modify the sequential procedure to first test $SupF_T(2)$ to identify if there are multiple breaks and then use $SupF_T(3|2)$ to decide if there are 2 or 3 breaks. The final column reports the number of breaks implied Liu et al. (1997) modified Bayesian information criteria.

**TABLE 4.9: STRUCTURAL BREAK MAGNITUDES AND TIMINGS**

Panel A: Industry Earnings-Price Ratios

| 1965Q4-2002Q4 | No. of | BREAK 1 | | | BREAK 2 | | | BREAK 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Break | DATE | + or - | SIZE | DATE | + or - | SIZE | DATE | + or - | SIZE |
| VW Ind | 3 | 1973Q3 | Up | 7.31% | 1981Q1 | Down | -5.50% | 1992Q2 | Down | -2.57% |
| EQ Ind | 3 | 1973Q3 | Up | 7.51% | 1980Q4 | Down | -5.57% | 1992Q1 | Down | -1.78% |
| | | | | | | | | | | |
| Engineering & Machinery | 2 | 1973Q3 | Up | 9.90% | 1980Q4 | Down | -7.52% | | | |
| Chemicals | 2 | 1973Q3 | Up | 7.75% | 1980Q4 | Down | -6.31% | | | |
| Support | 2 | 1973Q3 | Up | 8.45% | 1980Q4 | Down | -8.21% | | | |
| Electrical Eq. | 2 | 1973Q3 | Up | 7.73% | 1980Q4 | Down | -7.01% | | | |
| Auto & Parts | 2 | 1973Q2 | Up | 8.80% | 1980Q4 | Down | -8.66% | | | |
| General Retailers | 2 | 1973Q3 | Up | 4.88% | 1980Q3 | Down | -3.27% | | | |
| Construction & Building | 2 | 1973Q3 | Up | 9.13% | 1981Q1 | Down | -6.83% | | | |
| Beverages | 2 | 1973Q3 | Up | 5.42% | 1983Q4 | Down | -4.33% | | | |
| Media & Entertainment | 3 | 1973Q3 | Up | 8.82% | 1981Q1 | Down | -7.05% | 1991Q3 | Down | -3.16% |
| Aerospace & Defence | 0 | | | | | | | | | |
| Food Producers | 3 | 1973Q2 | Up | 7.85% | 1980Q4 | Down | -5.72% | 1992Q3 | Down | -1.98% |
| Leisure & Hotels | 2 | 1973Q3 | Up | 4.92% | 1981Q4 | Down | -5.07% | | | |
| Other Goods | 3 | 1973Q4 | Up | 7.67% | 1982Q2 | Down | -5.75% | 1992Q2 | Down | -2.60% |
| Oil & Gas | 2 | 1973Q3 | Up | 9.75% | 1986Q2 | Down | -9.34% | | | |
| Other Services | 2 | 1973Q2 | Up | 5.42% | 1980Q3 | Down | -4.57% | | | |
| Pharmaceuticals & Biotech | 2 | 1973Q4 | Up | 4.66% | 1981Q1 | Down | -4.51% | | | |

**TABLE 4.9 (CONTINUED)**

Panel B: Industry Dividend-Price Ratios

| 1965Q4-2002Q4 | No. of Break | BREAK 1 DATE | + or - | SIZE | BREAK 2 DATE | + or - | SIZE |
|---|---|---|---|---|---|---|---|
| VW Ind | 1 | 1993Q1 | Down | -1.84% | | | |
| EQ Ind | 2 | 1973Q4 | Up | 2.62% | 1982Q4 | Down | -2.79% |
| Engineering & Machinery | 2 | 1973Q3 | Up | 4.19% | 1983Q1 | Down | -3.95% |
| Chemicals | 2 | 1973Q4 | Up | 3.69% | 1983Q1 | Down | -3.50% |
| Support | 2 | 1973Q4 | Up | 2.97% | 1982Q4 | Down | -4.08% |
| Electrical Eq. | 2 | 1973Q3 | Up | 2.67% | 1980Q4 | Down | -3.16% |
| Auto & Parts | 2 | 1973Q3 | Up | 2.95% | 1982Q4 | Down | -3.45% |
| General Retailers | 2 | 1973Q4 | Up | 2.07% | 1982Q2 | Down | -1.82% |
| Construction & Building | 2 | 1973Q3 | Up | 3.28% | 1982Q3 | Down | -2.12% |
| Beverages | 2 | 1973Q4 | Up | 3.19% | 1985Q1 | Down | -3.87% |
| Media & Entertainment | 1 | 1992Q3 | Down | -3.12% | | | |
| Aerospace & Defence | 0 | | | | | | |
| Food Producers | 2 | 1973Q4 | Up | 2.59% | 1983Q3 | Down | -2.91% |
| Leisure & Hotels | 2 | 1973Q4 | Up | 2.81% | 1982Q4 | Down | -2.86% |
| Other Goods | 2 | 1973Q4 | Up | 3.06% | 1983Q3 | Down | -3.23% |
| Oil & Gas | 1 | 1993Q1 | Down | -2.25% | | | |
| Other Services | 0 | | | | | | |
| Pharmaceuticals & Biotech | 0 | | | | | | |

Table 4.8A reports results from $SupF_T$, $SupF_T(l+1|l)$ tests and LWZ criterion for the earnings-price ratio. What emerges particularly is that the $SupF_T(1)$ often indicates there are no structural breaks in the earnings-price ratios although the $SupF_T(2)$ and $SupF_T(3)$ tests indicate that there are 2 rather than 0 or 3 rather than 0 breaks respectively. The failure of the $SupF_T(1)$ test to reject the null of 0 breaks in favour of the alternative of 1 could be due to the series we examine appearing to go through a period of consistently high earnings-price ratio during the 1970s and then reverting back towards its previous mean in the 1980s or 1990s. The alternative hypothesis would have to allow for two breaks in the series in order to capture such a phenomena. Therefore we modify the procedure advocated by Bai and Perron (1998) to select the appropriate number of breaks in the series by using the $SupF_T(2)$ test to identify if there were at least two breaks in the series and then use the $SupF_T(3|2)$ test to examine if there were three rather than two breaks. Our empirical analysis reported in Table 4.8 suggests that there were multiple regimes in both market and industry earnings-price ratios over the 1966-2002 period. In general the results from using this modified procedure are similar to those indicated by the LWZ criterion. Although for 5 of the 16 industries the LWZ criteria suggests a higher number of breaks than those selected by the modified sequential procedure of $SupF_T$ tests, although this is to be expected since given Perron's (1997) findings that LWZ tends to find too many breaks for series which are serially correlated.

Table 4.8B reports results from $SupF_T$, $SupF_T(l+1|l)$ tests and LWZ criterion for the dividend-price ratio. A similar pattern to the earnings-price ratio tests surfaces since the $SupF_T(1)$ again often indicates there are no structural breaks in the dividend-price ratios although the $SupF_T(2)$ and $SupF_T(3)$ tests indicate that there are 2 rather than 0 or 3 rather than 0 breaks respectively. We suggest this is likely to be caused by a similar mechanism to the earnings-price ratio results that there is at least one positive and one negative break in many of the series which have only a marginal net impact on the dividend price ratio. Our empirical analysis reported in Table 5 suggests that there were multiple regimes in both market and industry dividend-price ratios over the 1966-2002 period. In general the results from using this modified sequential procedure are closer to those indicated by the LWZ criterion than the standard sequential approach. However, still for half of the 16 industries the LWZ criteria suggests a higher number of breaks than those selected by the modified sequential procedure of $\mathrm{SupF_T}$ tests. Although, part of this result is to be expected since given Perron's (1997) findings that LWZ tends to find too many breaks for series which are serially correlated. There is a suggestion that perhaps there are even more breaks in the dividend-price series than indicated by the modified sequential procedure.

We find in Table 4.9A that industry earnings-price ratios tend to have similar break timings consistent with a response to a pervasive economic risk factor. In fact, for almost all industries two breaks are found using the modified sequential procedure. Firstly, an upward break in the earnings-price ratio of all industries is found during the 1970s just prior to the first OPEC oil crisis in 1974 and the ensuing period of high inflation and economic instability and uncertainty in the UK economy. This finding of an upward mean break implies a rise in expected returns which is interesting since prior studies (such as Carlson et al. (2002) and Chapter 3 of this thesis) only find evidence of mean-breaks indicating a fall in expected returns.

Secondly, in almost all industries there is a downward break in the earnings-price ratio during the early 1980s. This break tends to be of approximately equal magnitude to the upward breaks of 1972-3. This also appears to be in response to a common economic factor since almost all industries were affected at approximately the same time. It is purported that this break could simply have occurred due to the resolution the economic instability and uncertainty faced by the UK economy in the mid-to-late 1970s. These two breaks almost entirely counteract each other, thus the overall net impact of the breaks on industry valuation ratios tends to be marginal.

Thirdly, however, only in three of the sixteen industries is there a significant downward mean break in the 1990s. Therefore, in stark contrast, to studies of the aggregate market we find little evidence of a common downward break in valuation ratios in the 1990s. For instance, Carlson, Pelz and Wohar (2002) report a downward structural break in the mean of fundamental-price ratios during the early 1990s in the US while Vivian (2005) finds a downward break in the UK dividend-price ratio at a similar time. Our aggregate market results do reveal a downward break in both equally-weighted and value-weighted earnings-price ratios during the early 1990s although the magnitude of the break is much more pronounced for the value-weighted index. The general interpretation of a shift in a valuation ratio is that it is indicative of a change in expected return, particularly since fundamental growth is difficult to predict. However, our industry results question whether this could have been the case for the break in the early 1990s in the UK. This is because if a change in expected returns had been caused by a pervasive economic risk factor then one would expect the valuation ratios of all industries to be affected. However, our results indicate that only three out of sixteen industries experienced a statistically significant shift in their earnings-price ratio during the 1990s. Since the overwhelming majority of industries' valuation ratios were relatively unaffected, it suggests that this result was not caused by a pervasive economic risk factor causing a change in expected returns. Perhaps, it is more likely this episode can be ascribed to a change in expectations of future fundamental growth in these particular industries.

**FIGURE 4.5: UK INDUSTRY EARNINGS-PRICE RATIO AND BEST-FIT LINES WITH MULTIPLE MEAN BREAKS.**

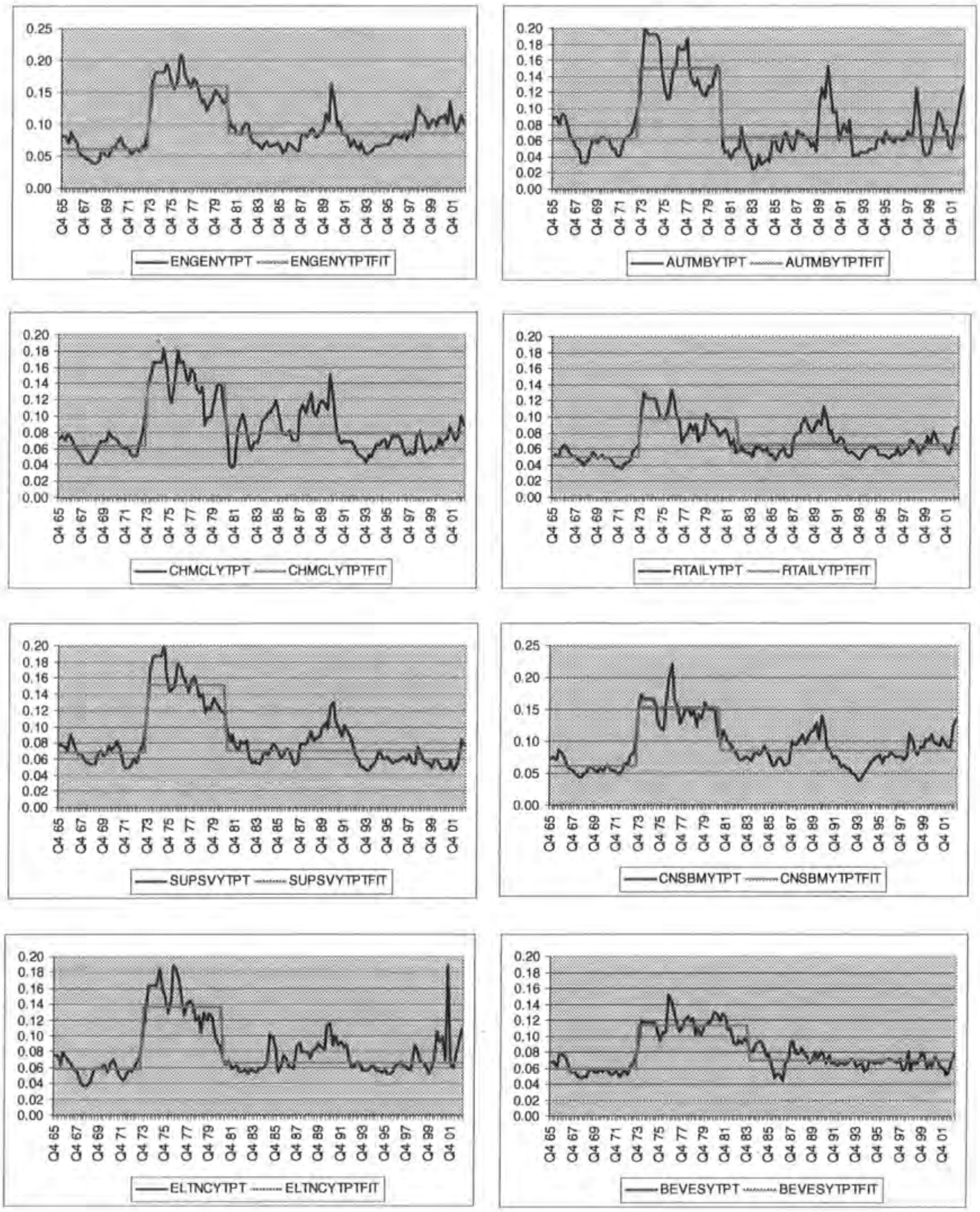
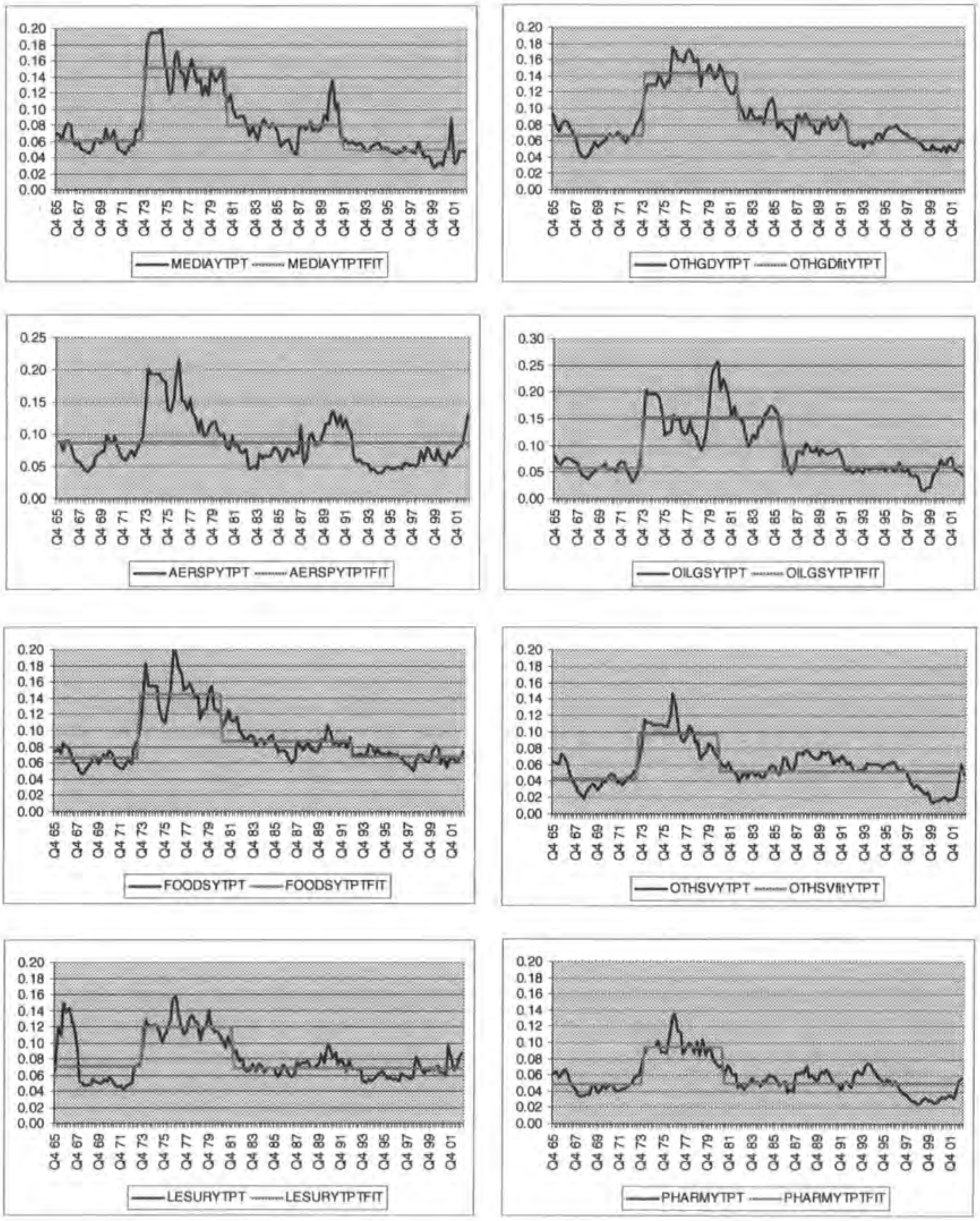


**FIGURE 4.5 (CONTINUED): UK INDUSTRY EARNINGS-PRICE RATIO AND BEST-FIT LINES WITH MULTIPLE MEAN BREAKS.**



## FIGURE 4.6: UK INDUSTRY DIVIDEND-PRICE RATIO AND BEST-FIT LINES WITH MULTIPLE MEAN BREAKS.

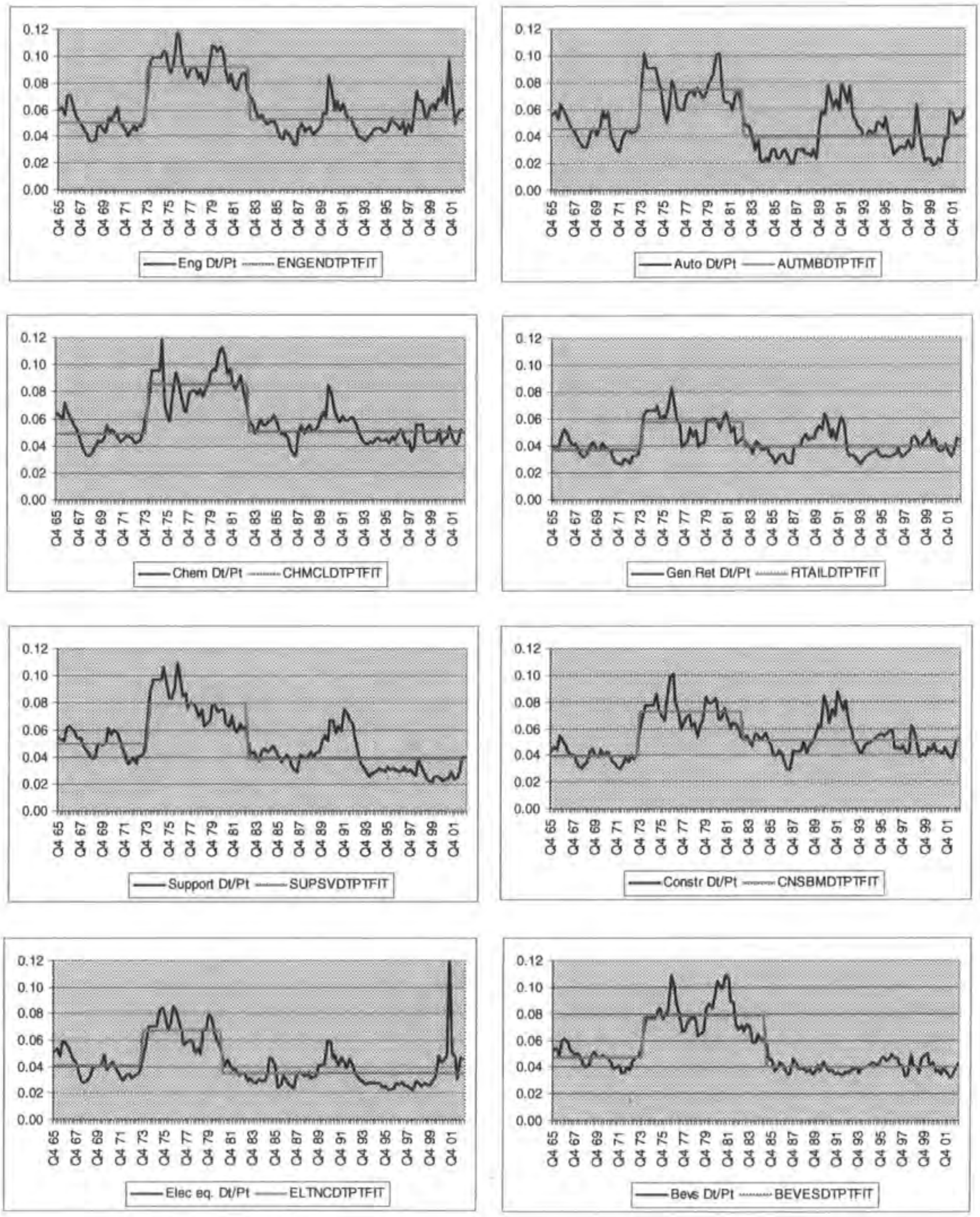
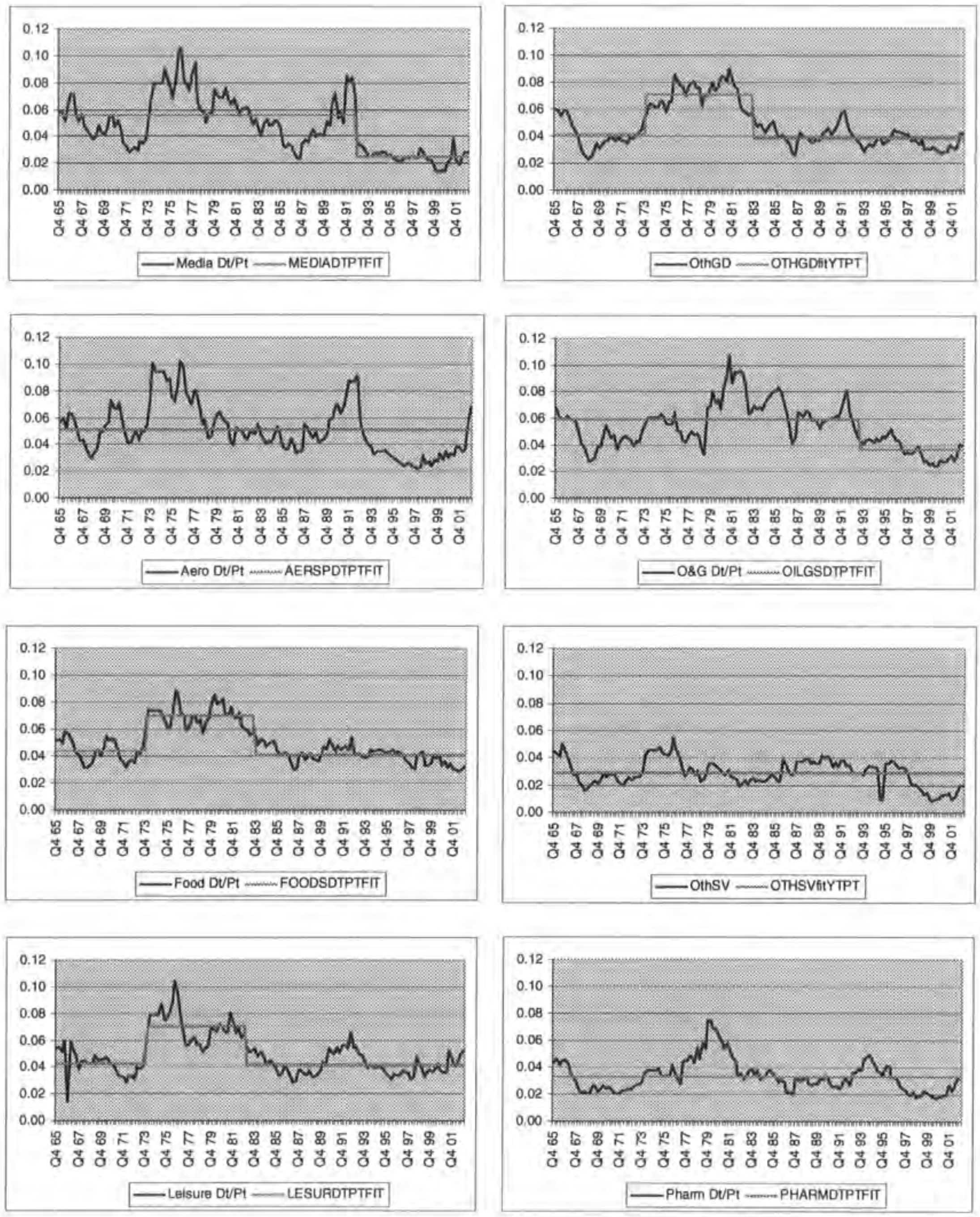


FIGURE 4.6 (CONTINUED): UK INDUSTRY DIVIDEND-PRICE RATIO AND BEST-FIT LINES WITH MULTIPLE MEAN BREAKS.



Furthermore, the net change from the structural breaks of earnings-price ratios tend to be rather small, thus our results are not supportive that expected returns fell overall during the period 1966-2002. Whilst in almost all industries at least two statistically significant breaks are found, the net impact of the change in valuation ratio is generally rather small. Furthermore, the timing of the breaks in almost all cases are prior to the 1990s, contrary to previous studies.

Consequently, these structural break results add further weight to our equity premia results that indicated the tendency for capital gains to be supported by earnings growth for 1966-2002. There is certainly little evidence to suggest that prices rose more rapidly than earnings over this period and hence paltry support for an overall fall in expected returns over 1966-2002.

We find in Table 4.9B that the results from industry dividend-price ratio break tests share a number of similarities with the results for the earnings-price ratios. Firstly, the dividend-price ratio results indicate that the industries tend to have similar break timings consistent with a response to a pervasive economic risk factor. In fact, for a large majority of industries two breaks are found using the modified sequential procedure. Firstly, an upward break in the dividend-price ratio in 11 of 16 industries is found during the 1970s just prior to the first OPEC oil crisis in. Secondly, in these same 11 industries there is a downward break in the dividend-price ratio during the early 1980s. This break tends to be of approximately equal magnitude to the upward breaks of 1973 and the net impact tends to be relatively small, but naturally there is some variation in impact across industries. These industries appear to be responding to a common economic factor since almost all industries were affected at approximately the same time. The results for the equally-weighted market index conform to the pattern of this majority of industries, namely only two breaks are found, at a timing in common with the industries and these offset each other almost exactly.

Thirdly, however, only in two of the sixteen industries is there a significant downward mean break in the 1990s. Therefore, in stark contrast, to studies of the aggregate market we find little evidence of a common downward break in valuation ratios in the 1990s. For instance, Carlson, Pelz and Wohar (2002) report a downward structural break in the mean of fundamental-price ratios during the early 1990s in the US while Vivian (2005) finds a downward break in the UK dividend-price ratio at a similar time. Our aggregate market results do reveal a downward break in value-weighted dividend-price ratios during the early 1990s. The general interpretation of a shift in a valuation ratio is that it is indicative of a change in expected return, particularly since fundamental growth is difficult to predict. However, our industry results question whether this could have been the case for the break in the early 1990s in the UK. This is because if a change in expected returns had been caused by a pervasive economic risk factor then one would expect the valuation ratios of all industries to be affected. Our results indicated that only two out of sixteen industries experienced a statistically significant shift in their dividend-price ratio during the 1990s. Since the overwhelming majority of industries' valuation ratios had little net change overall during our sample period, it suggests that this result was not caused by a pervasive economic risk factor causing a change in expected returns. Perhaps, it is more likely this episode can be ascribed to a change in expectations of future fundamental growth in these particular industries or due to changes in the composition of industries within the market portfolio. In general though our main finding here is that there was not a pervasive break in industry dividend-price ratios during the early 1990s.

In terms of the earnings growth model, consequently, these structural break results add further weight to our equity premia results that indicated the tendency for capital gains to be supported by earnings growth for 1966-2002. There is certainly little evidence to suggest that prices rose more rapidly than dividend over this period and hence paltry support for an overall fall in expected returns over 1966-2002. In terms of the dividend growth model, there appears little evidence either that there was a pervasive downward shift in expected returns, which would be necessary to explain to equity premia results. Consequently, for most industries the results relating to the dividend model are somewhat perplexing. This is in so far as there doesn't seem to have been a substantial downward shift in the dividend-price ratios of these industries but there tend to be large divergences between equity premium estimates from the dividend and the historical average models.

## 4.5 CONCLUSION

This Chapter's analysis suggests that whether investor's expectations of UK equity premia were approximately equal to the historical average depends upon the method used to calculate expected returns. We find the dividend growth model suggests UK equity premia since 1966 have been systematically lower than the historical average equity premia across the majority of UK industries. The dividend growth model results are consistent with the extant literature based on aggregate market studies of the US (Fama and French (2002) and Jagannathan et al. (2001)) and of the UK (Chapter 3 of this thesis).

However, when earnings growth is used to estimate expected equity premia then across most industry sub-sectors these estimates are much closer to the historical average, especially once the 1974 spike in stock prices is adjusted for. Thus, in general, the appreciation in stock prices over 1966-2002 appears to have been largely supported by earnings growth across industry portfolios. Further, when we aggregate the 16 'real' economy industries to form a market portfolio both on an equally weighted and a value weighted basis we find that capital gains have been largely supported by earnings growth.

There are strengths and weaknesses to using earnings growth rather than dividend growth to estimate expected returns[48]. However, the empirical analysis of this Chapter suggests that the evidence for the equity premium declining over the latter part of the 20th Century is mixed in the case of the UK and certainly the support for this hypothesis is not as strong as suggested by prior aggregate market studies (Jagannathan et al. (2001), Fama and French (2002)). Therefore from a UK corporate treasurer's perspective this suggests that the cost of equity capital might not have fallen over recent decades across UK industries. Thus, within many UK industries firms may not necessarily have benefitted from being able to raise equity funds more cheaply, as could be expected if there is a pervasive fall in equity premium across industries.

Nevertheless, in some industries we find a discrepancy between equity premia estimates especially when the dividend measure is used to estimate expected equity premia. We therefore investigate the cause of this finding. Was the average stock return since 1966 above (or below) investors' expectations because of either a) expectations of higher (lower) growth rates in the future or b) a decline (rise) in the

[48] See Chapter 4.1 for a fuller discussion of these points.

[50] $GP_t = (p_t - p_{t-1})/p_{t-1}$

discount rate. We include all industries in these investigations since industries which had approximately similar equity premia estimates can act as controls.

Industry panel results indicate both medium term dividend growth and earnings growth are highly predictable in the time-series. In particular, the consumption-fundamental ratio is the most important regressor underpinning findings of predictability. Forecasts of dividend and earnings growth from these models for the both one and five year horizons provide mixed evidence as to whether or not a change in expectations of future earnings growth can explain the remaining inconsistencies in our equity premia results.

At the industry level structural break tests indicate, firstly there have been multiple regimes for the valuation ratios over 1966-2002 and secondly the net impact of these multiple regimes depends on which measure of fundamental-price is examined. For earnings-price ratios the net impact has been marginal for most industries, whereas for dividend-price ratios the net impact has been a marked decline. Importantly, our evidence demonstrates that findings of a permanent decline in the aggregate market ratio of fundamental-price offered by studies of US and UK (Carlson et al. (2002), Vivian (2005)) during the 1990s does not translate well to industry earnings-price data. This finding casts doubt on aspersions that findings from previous studies were driven by a change in expected return since if the risk factor was systematic then this change should be felt across industry groupings. Nevertheless we do find common breaks in the industry valuation ratios, but these are not necessarily downwards as found in previous studies. The first major break, in fact, is upwards in 1973 just prior to the first OPEC Oil Crisis and is uniform across industries. A second major break is found in almost all industries during the early 1980s, which can again be linked to underlying economic conditions. These findings of common structural breaks, are suggestive that there was a systematic economic risk factor at work that affected expected returns in all industries.

The structural break results provide key new insights into the time-series variation in the equity premium. The empirical results suggest that there were movements in the UK expected equity premium during the 1970s and the 1980s as these were periods where almost all industries experienced shifts in valuation ratio. However, the structural break results also question whether there was any change in the expected equity premium during the 1990s (contrary to the US findings of Lettau et al. (2006). This is because during the 1990s only a small number of industries' valuation ratios experienced a regime change, whereas if there were a change in the equity premium one would expect almost all industries to be affected. Finally, structural break tests re-inforce the results from average equity premium estimates. Over the full sample period there is evidence for the majority of industries of substantive falls in the mean of the dividend-price ratio but there is limited evidence of falls for the earnings-price ratio. Hence the results are mixed, evidence from dividend-price ratio suggests a fall in equity premium whereas earnings-price evidence is more consistent with there being no change in equity premium.

# CHAPTER 5: THE EXPECTED SIZE PREMIUM: 1966-2002

## 5.1 INTRODUCTION

In this chapter we extend our previous analyses of the expected UK equity premium in an important direction to examine the "the premier stock market anomaly - the striking outperformance of smaller companies" (Dimson and Marsh (1999) p54). Our main research questions are important and hitherto appear to receive little attention in the literature. Are historical equity premia earnt by size portfolios expected? Is the the size premium itself expected? This Chapter examines if the historical performance of size sorted portfolios is consistent with the expected equity premium implied by fundamentals. Is it simply the case that the returns earnt by small companies are commensurate with them achieving superior underlying performance in terms of dividend growth or earnings growth than large corporations?

Our examination of the relationship between the historical premia and the fundamental performance of size portfolios is an avenue that has not previously been explored in the literature. Consequently, it promises to shed new light upon the size "anomaly" and deepen our understanding of the phenomena. If small firms have stronger fundamental growth than large firms then this could be an important first step towards explaining why on average small firms earn higher returns than large firms.

In Chapter 3 we discovered evidence suggesting that a decline in the UK market equity premium ($r_m$-$r_f$) occurred during the latter part of the 20th Century. This thesis extends the analysis further and novelly to examine the equity premium amongst different sub-sets of the aggregate market. We intend to determine how widespread this decline in equity premium actually is. In the current chapter, we conduct an analysis across portfolios formed on the basis of market capitalisation. If a decline in equity premia is apparent across the full range of firm size portfolios, this would also give us an indication as to whether or not the market equity premium decline was due to a systematic economic risk factor. This is because if there was a decline in equity premium then we would expect all firms regardless of size to be affected.

Whether or not the historical equity premium earnt by firms of different sizes is approximately equal to that which could be expected is of importance to various stakeholders. Firstly, the equity premium is a key determinant of a company's cost of equity capital. Thus from corporate financial management perspective then this study would be of use to those seeking to determine their cost of capital by observing the equity premium earnt by firms with similar size or size-value characteristics. However, if the historical equity premium mis-measures or is a poor guide to the expected equity premium then corporate managers could make sub-optimal financing decisions. For instance, if manager's made financing decisions based upon historical data that overestimated the cost of equity capital then *ceteris paribus* they would choose to use more debt financing for new investment projects. Secondly, from an asset allocation point of view it is of importance to ascertain whether past equity premia earnt by firms (of various sizes) could be expected or not. For instance if good past performance of small firms could be expected then asset allocation could be tilted towards such firms, however, if in contrast the good past performance of small firms could not be expected then an adjustment to asset allocation wouldn't be justified.

Thus far the literature on the equity premium focuses upon the *market* index and neglects to examine the *cross-sectional* implications if a fall in the market equity premium were to occur (with the notable exception of Chapter 4 of this thesis). If the equity premium declines, as the empirical analysis of the aggregate market in Chapter 3 implies, then this should impact all firms at a common time. We empirically investigate if this is the case for UK size and size-value sorted portfolios.

The main finding is that the very largest firms drive the fall in UK aggregate market valuation ratios during the 1990s. Given that firms in the smallest four quintiles do not experience shifts in valuation ratios during the 1990s, we question whether the move in UK market valuation ratios during the 1990s is really caused by a change in risk. Our results suggest the consumption risk explanation of Lettau et al. (2006) doesn't travel well.

However, by examining size portfolios, this Chapter also enables one of the most infamous stock market anomalies, the size premium, to be examined. The size premium, the return differential between small and large firms is a puzzle in its own right and has been referred to as such since its discovery by Banz (1981). This is because the size premium is a persistent pattern in stock returns that appears inconsistent with existing financial theory. Although Fama and French (1993, 1996) purport size to be an economic risk factor (in their three factor model), little empirical evidence has yet emerged as to what precisely this economic factor might be.

As Haugen (1995) mentions, "In the course of the last 10 years, financial economists have been struggling to explain ... the huge, predictable premiums in the cross-section of equity returns."

In this Chapter we thus have the additional goal also of discovering if the seeming decline in the expected equity premium during recent decades has been accompanied by a similar decline in the expected size premium. This would be of particular importance since recent studies of the cross-section of returns find size to play a vital role in explaining share performance and in combination with book-to-market ratio can explain as much, if not more, of cross-sectional returns than the market portfolio itself (Fama and French (1993)).

Has the size premium declined over recent years? This issue, of whether the return differential between small and large firms is time-varying has received some attention in the prior literature. Specifically in the US, Horowitz et al. (2000) find the size premium disappeared after its discovery in 1981, whilst Dimson and Marsh (1999) contend that the size premium went into reverse following its discovery in both the US and UK. Dimson and Marsh's post-discovery sample for the UK (1989-1997) is rather short covering just 9 years and hence we propose it is both legitimate and necessary to re-visit their propositions in light of a longer dataset that encompasses more recent market behaviour especially the adverse trading conditions of the new millennia. We are also able to extend prior research to examine if a change in size premia was expected. While a change in the size premium is interesting in its own right, it also potentially has important implications for the equity risk premium itself. Specifically if there is a shift in the size premium then this could be symptomatic of a change in the expected equity risk premium. This is an issue we examine in Section 5.4.2.

## 5.2 MODEL AND DATA DESCRIPTION

In this section we first outline the models used in this chapter, we then proceed to describe the data utilised in this study before assessing the statistical properties of this data. Finally we examine in detail the methodologies utilised in this chapter.

### 5.2.1 MODEL

In finance, the return in any time period, is given by equation 5.1. The simple proportion return ($R_t$) is the dividend paid ($d_t$) during that time period plus the change stock price ($p_t$-$p_{t-1}$) during that time period expressed as a proportion of the previous periods asset price ($p_{t-1}$) either as a decimal or percentage.

Simple Return Equation

$$(38)\qquad \begin{aligned} R_t &= (d_t + p_t - p_{t-1})/p_{t-1} \\ R_t &= d_t/p_{t-1} + (p_t - p_{t-1})/p_{t-1} \end{aligned}$$

In (38) we can separate the proportional return ($R_t$) into two distinct parts. The first part is the dividend yield ($d_t / p_{t-1}$ ) which is the dividend paid during the current time period t divided by the original asset price at time t-1. The second is the proportional capital gain ($p_t$ - $p_{t-1} / p_{t-1}$ ) given by the change in price between time t-1 and t divided by the original asset price.

This chapter focuses upon the expected equity premium following the approach of Fama and French (2002) to derive estimates of average stock returns. In their average return model, the average stock return ($R_t$) is simply the average dividend yield ($d_t$ / $p_{t-1}$) plus the average growth of prices ($GP_t$).

Average Return Model

$$(39)\qquad A(R_t) = A(d_t/p_{t-1}) + A(GP_t)$$

Equation 39 shows the average return model, where $A\ (\ )$ is the arithmetic average, $d_t$ is real dividend payments during the current time period t, $p_{t-1}$ is the price index at the previous time period t-1 and $d_t / p_{t-1}$ is the dividend yield. $GP_t^{50}$ is the proportional capital gain in time t as defined in equation 5.1.

If the dividend-price ratio $(d_t\ /\ p_t)$ has a constant mean then over extended periods of time the proportional change in prices must be matched by an almost equivalent proportional change in dividends. Since a constant mean is one condition that stationary variables must satisfy, it follows that if we have a stationary dividend-price series then dividend growth will give us an estimate of the expected growth of the share price. Consequently, we can obtain estimates from fundamentals of expected capital gains.

Similar intuition applies to any other variable that is in a long-term stable relationship with prices. Another possible and suitable candidate variable is earnings. As long as the earnings-price ratio has a constant mean then share price growth can be estimated using earnings growth, providing us with an alternative estimate of expected capital gains from underlying financial performance.

Dividend Growth Model

(40) $$A\ (RD_t) = A\ (d_t\ /\ p_{t-1}) + A\ (GD_t)$$

The Fama-French Dividend Growth Model is defined in equation 40 with the return of the dividend model $(RD_t)$ being given by the average dividend yield $(d_t /p_{t-1})$

plus the average dividend growth rate ($GD_t$). For a full description of the derivation of the dividend growth model see Chapter 3.2.1.

Earnings Growth Model

$$(41) \qquad A\,(RY_t) = A\,(d_t \;/\; p_{t-1}) + A\,(GY_t)$$

The earnings growth model is given by equation 41 where the return of the earnings growth model ($RY_t$) is defined as the average dividend yield ($d_t / p_{t-1}$) plus the earnings growth rate ($GY_t$). For a full description of the derivation of the earnings growth model see Chapter 4.2.2.

These models are derived using a minimal number of assumptions. The main assumption made is simply that the ratio of dividends to price or earnings to price respectively is stationary. In such circumstances dividend growth or earnings growth will provide an approximation of capital gains. Even if the series are not stationary, Fama and French (2002) claim the approach can still be employed provided the weaker condition that the series is mean-reverting or mean-reverting during each regime. They make the case that one can rationally expect there to be different regimes in the valuation ratios, primarily brought about because of permanent or highly persistent changes in factors determining asset prices. For example, if investors believed growth of fundamentals to have permanently increased then prices would rationally shift upward perhaps causing the appearance of a non-stationary section in the dividend-price and earnings-price ratio. Therefore, as long as valuation ratios exhibit mean-reversion during regimes it is posited that dividend growth and earnings growth will provide reasonable approximations of capital gains and the models developed by Fama and French can be employed.

Actually, when there are price shifts caused by rational factors Fama and French (2002) suggest that fundamentals are a superior way to estimate expected equity returns. Since, in the preceding example the increase in the growth rate was unexpected, investors' returns would be inflated due to the equity price rise which was due to good look in terms of favourable economic news.

This, however, poses a considerable challenge for the researcher to demonstrate that their use of the models in the place of any non-stationarities in the data is justified on the basis of rational price adjustment to unanticipated factors. If movements in valuation ratios were caused primarily by factors other than rational price adjustment, such as market optimism or mis-pricing then the Fama-French model will be inappropriate and yield defective results. Hence in section II.3 we address these issues in detail not only conducting unit-root tests on the base series but also analysing the impact of adjusting these series for the impact of outliers to establish when the valuation ratios are stationary and during which periods they are non-stationary.

### 5.2.2 DATA DESCRIPTION

Our data for this chapter is drawn from the same set of firms as in chapter 4 which studied the industry equity premium. However, in this chapter we analyse the data in terms of size and size-value sorted portfolios rather than based upon industry classifications. For a full description of the basic data sample used see Chapter 4.2.1.

To review our sample comprises all UK non-financials (in the Datastream database) trading on the LSE at any time between 1966-2002. Firms from financial industries are discarded, in line with similar studies, due to them having much greater scope for earnings management than 'real' economy firms. The sample includes delisted companies as well as those still trading. A total of 2,925 firms are included in the sample, of which 1,920 had delisted and 1,005 were still trading. For each of these firms, we collected price, dividend-price, price-earnings and market capitalisation data from the Datastream database. Importantly, our dataset is free from the survivor bias in many quoted indices.

Horowitz et al. (2000) found that if firms with market capitalisation below \$5m are removed from the sample then over recent years the size premium has largely disappeared. Moreover, the majority of the extant literature finds that the size premium is largely concentrated in the very smallest equities. In order to re-examine if the UK size premium has disappeared, or even reversed (as suggested by Dimson and Marsh (1999)) we exclude the very smallest firms, those with market capitalisations below £5m (real 2002 £'s) from our sample. We can report without showing the details here that if these smallest firms are included then the results are more in favour of a positive size premium, in line with the prior literature. By excluding firms with market capitalisation below £5m we provide ourselves with the best opportunity of discovering a disappearing or reversing size premium. If we were to find a positive size premium is evident even after the very smallest firms are removed this simply strengthens the case of the existence of a positive size premium.

We use two separate methods to divide the firms into portfolios. Firstly, we used a one-way sort on market capitalisation to divide firms into five quintile portfolios based upon their market capitalisation at the end of the preceding year t-1 for the purposes of analysis during year t. We also calculate a size premium measure from the one way sort as the difference between the smallest and largest quintile portfolios (Q5-Q1).

Secondly, we conducted a two-way independent sort on firm size and value following Fama and French (1993). We divide firms into two size categories, small and big, using the median firm size at the end of period t-1 as the breakpoint. All firms are then independently sorted on the value measure and divided into three value categories, low, medium and high, with breakpoints at the 30th and 70th percentile. This provides six portfolios: small-low (SL), small-medium (SM), small-high (SH), big-low (BL), big-medium (BM) and big-high (BH). We use these portfolios to calculate the small minus big (SMB) portfolio in the same manner as Fama and French (1993):

$$((SL + SM + SH)/3) - ((BL + BM + BH)/3) \tag{42}$$

For our value metric, unfortunately, we are not able to follow Fama and French (1993) who use the book-to-market ratio since Datastream currently only has very limited coverage of the book-to-market ratio; specifically book-to-market is not available from Datastream for any UK firms prior to 1980 and even for the first decade 1980-1990, it appears to cover only a limited sub-set of firms quoted on Datastream. However, two other variables which have also been extensively used as value indicators in the literature, namely the earnings-price and dividend-price ratio are available for our whole sample period. In this chapter we report the results using the earnings-price ratio as the value indicator, although we can report without showing the details here that the use of dividend-price as the value indicator has very little influence upon our results.

## TABLE 5.1: FIRM COUNT

| Portfolio | Full Sample Average | Full Sample Min | Full Sample Max | Sub-sample Averages 1966-1978 | Sub-sample Averages 1979-1990 | Sub-sample Averages 1991-2002 |
|---|---|---|---|---|---|---|
| Size Quintiles | 163.54 | 51 | 233 | 110.00 | 179.65 | 205.20 |
| SL | 86.41 | 18 | 158 | 49.23 | 112.00 | 101.08 |
| BL | 141.08 | 55 | 218 | 106.62 | 143.92 | 175.58 |
| SM | 185.68 | 72 | 270 | 117.77 | 201.33 | 243.58 |
| BM | 118.03 | 49 | 177 | 89.85 | 135.00 | 131.58 |
| SH | 107.77 | 64 | 152 | 97.73 | 109.83 | 109.50 |
| BH | 119.96 | 38 | 186 | 69.88 | 136.33 | 157.83 |

Table 5.1 provides descriptive statistics on the numbers of firms within each size quintile and two way sorted size-value portfolio during the sample period. Of course on average each size quintile has the same number of firms and so just a single figure is reported in the table. For the full sample, on average there are approximately 164 firms in each size quintile. However, the number of LSE listed non-financial firms on Datastream appears to have increased over time. Over 1966-1978 on average there were 110 firms in each size quintile rising to 179.65 for 1979-1990 and reaching 205.20 for 1991-2002. This reflects the relatively limited coverage of firms by Datastream prior to the early 1970s.

For the size-value sorted portfolios there is also a tendency for the number of firms to increase after the 1966-1978 period. In fact, for almost all portfolios the minimum number of firms is during 1966-1978. We see that there is a cross relationship between size and value. This relationship is most apparent amongst the low value firms, for which there are a disproportionately low number of small firms; on average there are 86.41 firms in SL portfolio but 141.08 in BL portfolio. If there were no correlation between size and value these numbers would be equal[51]. However, we also find that there are a disproportionately large number of small firms in the middle value category during all periods and generally a slightly smaller number of small firms in the high value group. Thus although there does seem to be a relationship between size and value amongst UK non-financials, the relationship appears to be neither linear nor monotonic.

Annually rebalanced value-weighted price, earnings-price, dividend-price, earnings and dividends were then calculated for all portfolios, using the same method as in section 2.1 of chapter 4. To be included in the sample each firm must have been trading for at least four quarters to be included in the sample for the next year. The series we calculate are a portfolio concept and relate to the firms in that portfolio during the current year t. The weight attributed to each firm is based on the previous year end market capitalisation as a proportion of the relevant portfolio total capitalisation. We stress that the earnings attributed to the portfolios during year t are those which have been reported to the market during year t. Consequently the growth measures used in this study refer to the earnings of portfolio z in time t relative to the earnings of portfolio z in time t-1. And analogously for dividend growth, we calculate the total dividends accruing to portfolio z in time t relative to the total dividends of portfolio z in time t-1.

UK data on the consumer price index and three-month treasury bill rate were gathered from the IMF's International Financial Statistics database. Consumption data on individual series for non-durables and for services were taken from the UK Office for National Statistics (ONS) and these series were combined to form our measure of consumer expenditure. Similarly to the previous empirical chapters, we examine the

[51] In other words of the 30% firms with lowest earnings-price ratios, approximately two-thirds of these are larger than median market value (Big) and about one-third littler than median market value (Small).

data in real terms throughout since we believe economic agents are primarily concerned about the purchasing power of their income, although our methodology is equally applicable to nominal values.

### 5.2.3 UNIT ROOT TESTS

Stationarity, in so much as the relevant valuation ratios having a constant mean is a central issue for our dividend growth and earnings growth models, as outlined in Chapter 5.2.1. These models are based upon the assumption that the ratio of fundamental to price having a constant mean in order for dividend growth or earnings growth to give accurate estimates of the capital gain of the share index. Although, Fama and French (2002) forcefully assert that their method is robust to reasonable forms of non-stationarity. More generally, stationarity is an important issue since it is a pre-requisite for OLS regression analysis to be reliably conducted.

#### 5.2.3.1 EMPIRICAL RESULTS OF UNIT ROOT TESTS: 1966-2002

For the dividend-price ratio, Table 5.2 panel A indicates that the four largest quintiles dividend-price ratios are stationary. However, the smallest quintile (Q5) has a non-stationary dividend-price ratio. The quintile size premium (Q5-Q1) dividend price ratio is also non-stationary. However, these apparent non-stationarities could be caused by shifts in the means of the variables, quite possibly this could be caused by changes in payout policy. We'll proceed with our analysis and carefully interpret the results relating to these portfolios.

The dividend-price ratios for the two-way sorted size-value portfolios are all found to be stationary apart from the small size, low value firms (SL). However, SL firms are perhaps the most likely to adopt a zero-dividend policy since these are firms with high growth opportunities and potential to expand and thus the most likely to retain all earnings within the firm. However, the two size premium measures here also have stationary dividend-price ratios and thus the analysis of these can proceed normally.

For the earnings-price ratio we find that all five size quintiles are stationary. However, the smallest quintile (Q5) is only stationary at the 10% significance level. Similarly, the quintile size premium (Q5-Q1) earnings price ratio is also stationary at the 10% significance level. Given the notoriously poor size and power properties of the ADF tests we proceed as ordinary with the empirical work for these portfolios

The earnings-price ratios of the two-way sorted size-value portfolios are all found to have stationary earnings price ratios. The SMB earnings-price ratio is also stationary, however the 1WSMB earnings-price ratio just fails to reject the null of non-stationarity at the 10% level. This will be borne in mind in the interpretation of the subsequent analysis.

To clarify, we produce estimates of the equity premia even if the relevant valuation ratios are found to be non-stationary since the models employed are, "robust to reasonable non-stationarity of $D_t/P_t$ and $Y_t/P_t$." (Fama and French, 2002 p642) We also provide regression results for individual portfolio regressions even when a series is suspected to be non-stationary, the results of which are interpreted with care.

# TABLE 5.2: UNIT ROOT TESTS ON SIZE PORTFOLIOS (1966-2002)

Panel A: Augumented Dickey Fuller Tests on Dividend-price ratio and Constant

$$\Delta\left(D_t / P_t\right) = \mu + \omega^*\left(D_{t-1} / P_{t-1}\right) + \sum_{p=1}^{P} \omega_p \Delta\left(D_{t-p} / P_{t-p}\right) + \varepsilon_t$$

| Size Quintile Portfolios | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| Q1 | ADF (0) | -3.93 | -2.96 | Reject $h_0$ | Stationary |
| Q2 | ADF (0) | -3.71 | -2.96 | Reject $h_0$ | Stationary |
| Q3 | ADF (0) | -4.11 | -2.96 | Reject $h_0$ | Stationary |
| Q4 | ADF (0) | -3.58 | -2.96 | Reject $h_0$ | Stationary |
| Q5 | ADF (0) | -2.54 | -2.96 | Accept $h_0$ | Non-stationary |
| Q5-Q1 | ADF (0) | -2.30 | -2.96 | Accept $h_0$ | Non-stationary |

| Size-Value Portfolios | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| SL | ADF (0) | -2.32 | -2.96 | Accept ho | Non-stationary |
| BL | ADF (0) | -3.64 | -2.96 | Reject $h_0$ | Stationary |
| SM | ADF (0) | -3.35 | -2.96 | Reject $h_0$ | Stationary |
| BM | ADF (0) | -4.19 | -2.96 | Reject $h_0$ | Stationary |
| SH | ADF (0) | -4.17 | -2.96 | Reject $h_0$ | Stationary |
| BH | ADF (0) | -4.18 | -2.96 | Reject $h_0$ | Stationary |
| SMB | ADF (0) | -3.28 | -2.96 | Reject $h_0$ | Stationary |
| 1S-B | ADF (0) | -3.12 | -2.96 | Reject $h_0$ | Stationary |

Panel B: Augumented Dickey Fuller Tests on Earnings-price ratio and Constant

$$\Delta\left(Y_t / P_t\right) = \mu + \omega^*\left(Y_{t-1} / P_{t-1}\right) + \sum_{p=1}^{P} \omega_p \Delta\left(Y_{t-p} / P_{t-p}\right) + \varepsilon_t$$

| Size Quintile Portfolios | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| Q1 | ADF (0) | -3.60 | -2.96 | Reject $h_0$ | Stationary |
| Q2 | ADF (0) | -3.61 | -2.96 | Reject $h_0$ | Stationary |
| Q3 | ADF (0) | -3.47 | -2.96 | Reject $h_0$ | Stationary |
| Q4 | ADF (0) | -3.29 | -2.96 | Reject $h_0$ | Stationary |
| Q5 | ADF (0) | -2.88 | -2.96 | Reject $h_0$ | *Stationary |
| Q5-Q1 | ADF (0) | -2.82 | -2.96 | Reject $h_0$ | *Stationary |

| Size-Value Portfolios | Test | Test Stat | Critical Value | Decision | Inference |
|---|---|---|---|---|---|
| SL | ADF (0) | -3.06 | -2.96 | Reject $h_0$ | Stationary |
| BL | ADF (0) | -3.29 | -2.96 | Reject $h_0$ | Stationary |
| SM | ADF (0) | -3.47 | -2.96 | Reject $h_0$ | Stationary |
| BM | ADF (0) | -3.74 | -2.96 | Reject $h_0$ | Stationary |
| SH | ADF (0) | -3.32 | -2.96 | Reject $h_0$ | Stationary |
| BH | ADF (0) | -3.77 | -2.96 | Reject $h_0$ | Stationary |
| SMB | ADF (0) | -3.96 | -2.96 | Reject $h_0$ | Stationary |
| 1S-B | ADF (0) | -2.61 | -2.96 | Accept $h_0$ | Non-stationary |

* Indicates inference of stationary at the 10% significance level

## 5.3 ANNUAL SIZE PORTFOLIO RETURNS

### 5.3.1.1 SIZE PORTFOLIOS: ONE WAY SORT

Our results find a strong positive equity premium in all portfolios over 1966-2002. The equity premium is increasing as firm size decreases from 6.73% p.a. for the largest quintile (Q1) to 9.83% p.a. for Q3 to 14.21% for the smallest quintile (Q5), which amongst the size quintiles is monotonic. This is suggestive of a pervasive relationship between size and returns. Moreover, the size premium, as measured by the difference between Q5 and Q1 is 7.48% p.a., which is even larger than the equity premium for the largest firms (6.93% p.a.). An interesting feature of the results for other size portfolios is that the returns for Q2 and Q4 are much closer to Q3 indicating that it is really the quintile of largest firms alone that have particularly low returns and the quintile of smallest firms that have exceptionally high returns. This can be illustrated by the fact the Q4-Q2 return premium is less than 1.5% p.a., whilst the Q5-Q1 return premium is almost 7.5% p.a.

In terms of the expected equity premium over 1966-2002, this is also found to be positive for all size quintiles and a positive size premium is found. Expected returns increase monotonically across size quintiles. However the estimated expected returns especially by the dividend growth method and also, if to a lesser degree, by the earnings growth approach are smaller than the historical average return. For the largest firms Q1 the dividend growth equity premium estimate is 3.11%, the earnings growth equity premium estimate is 4.66% and the historical premium was 6.73%. Thus the expected premium was more than 2% less than the historical premia if calculated by the earnings growth model and more than 3.5% less than the historical premia if calculated by the dividend growth model. The scale of this discrepancy between historical and expected equity premia generally decrease as size declines for the earnings growth model but generally increase as size falls for the dividend growth model. Therefore, for smallest quintile (Q5), the equity premia estimates are 9.49% for the dividend growth model, 12.79% for the earnings growth model and 14.21% for the historical average model. However, there is consensus amongst the three differing methods that a considerable size premium existed over 1966-2002 and the magnitudes of this premium are fairly similar. The historical average size premium was 7.48% p.a., whilst that implied by dividend growth was 6.38% and that implied by earnings growth was 8.12%.

### 5.3.1.2 IMPACT OF 1974 STOCK MARKET CRASH

There was a stock market crash in 1974, which reversed almost entirely the following year. Such a substantial decline, followed by a rapid rise could have inflated our average historical returns since these are based on the arithmetic average. We use the same method to neutralise the impact of this as in our empirical analysis of industry portfolios in Chapter 4. We refer readers to section 4.3 of Chapter 4 for a fuller explanation. Intuitively, the impact of such a temporary inverse spike in stock prices upon our results can be simply illustrated. Assume there were a 50% fall in stock prices during 1974 followed by a 100% rise in 1975 would leave prices in December 1975 the same as in December 1973. However, the arithmetic average would give an average capital gain of 25% p.a. over the two years. Consequently, such extreme movements in share prices can bias upwards the arithmetic average. This bias could be large, in the example above it would be in excess of 1% p.a. even when averaged over the whole sample period. If we neutralise the impact of this shock to share prices, do our equity premia estimates align themselves more closely?

Similar to our results in Chapter 4 relating to the industry equity premium, we also find for size portfolios that the estimated values of historical returns are substantially affected and biased upwards by the 1974 market crash. The impact of the market turbulence of 1974-5 seems to be most acutely felt by the larger stocks. The adjustment reduces the largest quintile (Q1) historical average premia from 6.73% to 5.25%, a difference of 1.48% and the second largest from 9.24% to 7.36%, a change of approaching 2%. Whereas for the smallest stocks (Q5) the premia falls less than a percent from 14.21% to 13.28% and for the second smallest quintile (Q4) by slightly more than one percent from 10.65% to 9.38%. These results imply a further difficulty for economic explanations of the size premium, namely they imply that returns of large stocks were affected more than small stocks by this extreme adverse market movement. That is, during this financial market crash then large companies are more sensitive to its impact than small companies. Asset pricing theory would suggest a size premium could be justified if small stocks performed worse than large stocks during bad times. If one defines a stock market fall as a bad time, then according to this theory clearly small firms should be more sensitive to it than large firms. Our empirical evidence, however, points completely to the contrary.

We find estimates of expected returns via dividends or earnings are only marginally affected, if at all by the 1974 market crash. In fact, none of the expected equity premia estimates are affected by more than 0.1%. This supports Fama and French's (2002) assertion that dividends and earnings can provide more precise estimates of expected returns since they are relatively insensitive to the extreme market movements during 1974-1975.

# TABLE 5.3: ONE-WAY SIZE SORTED PORTFOLIO ESTIMATES OF FUNDAMENTAL GROWTH RATES AND VALUATION RATIOS

Panel A: 1966-2002

| | Sample | Inf | $F_t$ | $DY_t$ | $D/P_t$ | $Y/P_t$ | $D/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2002 | 7.03% | 1.61% | 4.53% | 4.18% | 7.37% | 58.72% | 0.17% | 1.72% | 3.79% |
| Q2 | 1966-2002 | 7.03% | 1.61% | 5.00% | 4.55% | 7.88% | 59.45% | 1.54% | 3.75% | 5.85% |
| Q3 | 1966-2002 | 7.03% | 1.61% | 5.34% | 4.86% | 8.04% | 62.27% | 2.28% | 4.46% | 6.10% |
| Q4 | 1966-2002 | 7.03% | 1.61% | 5.64% | 5.10% | 8.47% | 61.94% | 2.20% | 5.07% | 6.62% |
| Q5 | 1966-2002 | 7.03% | 1.61% | 5.59% | 4.87% | 8.01% | 62.23% | 5.50% | 8.80% | 10.22% |
| Q5-Q1 | 1966-2002 | 0.00% | 0.00% | 1.04% | 0.69% | 0.63% | 3.50% | 5.34% | 7.08% | 6.43% |

Panel B: 1966-2002 spike adjust

| | Sample | Inf | $F_t$ | $DY_t$ | $D/P_t$ | $Y/P_t$ | $D/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2002 | 7.03% | 1.61% | 4.53% | 4.18% | 7.37% | 58.72% | 0.16% | 1.70% | 2.31% |
| Q2 | 1966-2002 | 7.03% | 1.61% | 5.00% | 4.55% | 7.88% | 59.45% | 1.51% | 3.73% | 3.96% |
| Q3 | 1966-2002 | 7.03% | 1.61% | 5.34% | 4.86% | 8.04% | 62.27% | 2.28% | 4.41% | 4.62% |
| Q4 | 1966-2002 | 7.03% | 1.61% | 5.64% | 5.10% | 8.47% | 61.94% | 2.20% | 5.03% | 5.35% |
| Q5 | 1966-2002 | 7.03% | 1.61% | 5.59% | 4.87% | 8.01% | 62.23% | 5.47% | 8.77% | 9.29% |
| Q5-Q1 | 1966-2002 | 0.00% | 0.00% | 1.04% | 0.69% | 0.63% | 3.50% | 5.31% | 7.07% | 6.98% |

Panel C: 1966-1984 spike adjust

| | Sample | Inf | $F_t$ | $DY_t$ | $D/P_t$ | $Y/P_t$ | $D/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-1984 | 9.76% | -0.50% | 5.21% | 4.75% | 8.22% | 61.25% | -1.06% | 2.00% | 1.60% |
| Q2 | 1966-1984 | 9.76% | -0.50% | 5.91% | 5.27% | 8.54% | 64.88% | 0.89% | 2.43% | 4.32% |
| Q3 | 1966-1984 | 9.76% | -0.50% | 6.21% | 5.52% | 8.56% | 67.87% | 2.81% | 4.81% | 5.53% |
| Q4 | 1966-1984 | 9.76% | -0.50% | 6.71% | 5.96% | 9.20% | 68.46% | 2.60% | 4.88% | 5.68% |
| Q5 | 1966-1984 | 9.76% | -0.50% | 7.07% | 6.04% | 9.18% | 69.71% | 7.08% | 9.84% | 9.77% |
| Q5-Q1 | 1966-1984 | 0.00% | 0.00% | 1.86% | 1.29% | 0.96% | 8.47% | 8.14% | 7.85% | 8.17% |

Panel D: 1988-1998

| | Sample | Inf | $F_t$ | $DY_t$ | $D/P_t$ | $Y/P_t$ | $D/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1989-1998 | 4.33% | 3.78% | 4.20% | 3.79% | 6.34% | 60.38% | 3.39% | 0.86% | 6.59% |
| Q2 | 1989-1998 | 4.33% | 3.78% | 4.22% | 4.09% | 7.05% | 59.09% | 3.43% | 2.41% | 1.23% |
| Q3 | 1989-1998 | 4.33% | 3.78% | 4.39% | 4.35% | 7.40% | 60.20% | 1.96% | 1.48% | -0.61% |
| Q4 | 1989-1998 | 4.33% | 3.78% | 4.40% | 4.44% | 7.71% | 57.94% | 1.75% | -0.34% | -1.53% |
| Q5 | 1989-1998 | 4.33% | 3.78% | 3.97% | 3.90% | 6.88% | 57.66% | 3.06% | 3.18% | 0.89% |
| Q5-Q1 | 1989-1998 | 0.00% | 0.00% | -0.22% | 0.10% | 0.54% | -2.72% | -0.33% | 2.32% | -5.70% |

Panel E: 1985-2002

| | Sample | Inf | $F_t$ | $DY_t$ | $D/P_t$ | $Y/P_t$ | $D/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1985-2002 | 3.88% | 3.92% | 3.87% | 3.60% | 6.40% | 56.93% | 1.45% | 1.40% | 3.05% |
| Q2 | 1985-2002 | 3.88% | 3.92% | 3.99% | 3.77% | 7.10% | 53.94% | 2.16% | 5.09% | 3.58% |
| Q3 | 1985-2002 | 3.88% | 3.92% | 4.33% | 4.11% | 7.38% | 56.59% | 1.72% | 4.00% | 3.66% |
| Q4 | 1985-2002 | 3.88% | 3.92% | 4.44% | 4.17% | 7.58% | 55.46% | 1.77% | 5.19% | 5.00% |
| Q5 | 1985-2002 | 3.88% | 3.92% | 3.95% | 3.58% | 6.68% | 54.21% | 3.78% | 7.64% | 8.78% |
| Q5-Q1 | 1985-2002 | 0.00% | 0.00% | 0.09% | -0.01% | 0.28% | -2.72% | 2.33% | 6.25% | 5.73% |

For variable descriptions see notes to Table 3.3.

# TABLE 5.4: ONE-WAY SORTED SIZE PORTFOLIO ESTIMATES OF EQUITY RETURNS AND EQUITY PREMIA (1966-2002)

Panel A: 1966-2002

| Portfolio | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2004 | 4.71% | 6.27% | 8.34% | 3.11% | 4.66% | 6.73% | 3.63% | 2.07% |
| Q2 | 1966-2004 | 6.54% | 8.76% | 10.85% | 4.93% | 7.15% | 9.24% | 4.31% | 2.09% |
| Q3 | 1966-2004 | 7.62% | 9.79% | 11.44% | 6.01% | 8.19% | 9.83% | 3.82% | 1.65% |
| Q4 | 1966-2004 | 7.83% | 10.70% | 12.25% | 6.23% | 9.10% | 10.65% | 4.42% | 1.55% |
| Q5 | 1966-2004 | 11.10% | 14.39% | 15.82% | 9.49% | 12.79% | 14.21% | 4.72% | 1.42% |
| Q5-Q1 | 1966-2004 | 6.38% | 8.12% | 7.48% | 6.38% | 8.12% | 7.48% | 1.09% | -0.65% |

Panel B: 1966-2002 Spike adjusted

| Portfolio | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2004 | 4.71% | 6.25% | 6.86% | 3.10% | 4.65% | 5.25% | 2.15% | 0.60% |
| Q2 | 1966-2004 | 6.51% | 8.73% | 8.96% | 4.91% | 7.12% | 7.36% | 2.45% | 0.23% |
| Q3 | 1966-2004 | 7.62% | 9.75% | 9.96% | 6.01% | 8.14% | 8.35% | 2.34% | 0.21% |
| Q4 | 1966-2004 | 7.83% | 10.67% | 10.98% | 6.22% | 9.06% | 9.38% | 3.15% | 0.31% |
| Q5 | 1966-2004 | 11.07% | 14.37% | 14.88% | 9.46% | 12.76% | 13.28% | 3.81% | 0.52% |
| Q5-Q1 | 1966-2004 | 6.36% | 8.11% | 8.03% | 6.36% | 8.11% | 8.03% | 1.67% | -0.09% |

Panel C: 1966-1984 Spike adjusted

| Portfolio | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2004 | 4.15% | 7.21% | 6.81% | 4.65% | 7.71% | 7.32% | 2.66% | -0.39% |
| Q2 | 1966-2004 | 6.81% | 8.35% | 10.24% | 7.31% | 8.85% | 10.74% | 3.43% | 1.89% |
| Q3 | 1966-2004 | 9.02% | 11.02% | 11.75% | 9.53% | 11.53% | 12.25% | 2.72% | 0.73% |
| Q4 | 1966-2004 | 9.31% | 11.59% | 12.39% | 9.82% | 12.10% | 12.89% | 3.07% | 0.80% |
| Q5 | 1966-2004 | 14.15% | 16.91% | 16.84% | 14.65% | 17.41% | 17.34% | 2.69% | -0.07% |
| Q5-Q1 | 1966-2004 | 10.00% | 9.71% | 10.02% | 10.00% | 9.71% | 10.02% | 0.02% | 0.32% |

Panel D: 1985-2002

| Portfolio | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2004 | 5.31% | 5.26% | 6.92% | 1.39% | 1.34% | 3.00% | 1.61% | 1.65% |
| Q2 | 1966-2004 | 6.16% | 9.08% | 7.57% | 2.24% | 5.17% | 3.65% | 1.42% | -1.51% |
| Q3 | 1966-2004 | 6.07% | 8.34% | 8.00% | 2.15% | 4.42% | 4.08% | 1.94% | -0.34% |
| Q4 | 1966-2004 | 6.20% | 9.63% | 9.43% | 2.28% | 5.71% | 5.52% | 3.23% | -0.19% |
| Q5 | 1966-2004 | 7.73% | 11.60% | 12.74% | 3.81% | 7.68% | 8.82% | 5.01% | 1.14% |
| Q5-Q1 | 1966-2004 | 2.42% | 6.34% | 5.82% | 2.42% | 6.34% | 5.82% | 3.40% | -0.51% |

Panel E: 1989-1998

| Portfolio | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| Q1 | 1966-2004 | 7.59% | 5.05% | 10.78% | 3.81% | 1.27% | 7.00% | 3.20% | 5.73% |
| Q2 | 1966-2004 | 7.64% | 6.63% | 5.44% | 3.87% | 2.85% | 1.66% | -2.20% | -1.19% |
| Q3 | 1966-2004 | 6.35% | 5.86% | 3.78% | 2.57% | 2.09% | 0.00% | -2.57% | -2.09% |
| Q4 | 1966-2004 | 6.15% | 4.05% | 2.87% | 2.37% | 0.27% | -0.91% | -3.28% | -1.18% |
| Q5 | 1966-2004 | 7.04% | 7.15% | 4.86% | 3.26% | 3.37% | 1.08% | -2.18% | -2.29% |
| Q5-Q1 | 1966-2004 | -0.55% | 2.10% | -5.93% | -0.55% | 2.10% | -5.93% | -5.38% | -8.02% |

For variable descriptions see notes to Table 3.3.

The net result is that the divergence between equity premia estimates narrows considerably after the impact of the 1974 market crash is neutralised. In fact, Panel B Table 5.4 indicates the expected equity premia from the earnings growth model and the historical average premia are quite close to one another for the full sample period. For instance, for the smallest firms it is 0.52% p.a. whilst the largest discrepancy for any of the size quintiles is for the largest firms is a modest 0.60% p.a. Consequently, the divergence between these models estimate of the size premium is just 0.08%, the historical premia is 8.03% and the earnings growth premia is 8.11%.

However, the dividend growth estimate of equity premia is still considerably below that of the other methods. For the size premium it implies a value of 6.36%, more than 150 basis points below that given by the other methods. For the size quintiles the discrepancy between the dividend growth model estimates and the actual returns are substantial across all size quintiles. Dividend growth implies a premia of 3.10% for the largest firms (Q1) rising to 6.01% for the median quintile (Q3) and is 9.46% for the smallest firms (Q5). However, the discrepancies between these estimates and the historical premia are 2.15%, 2.34% and 3.81% respectively. Thus the tendency is for this discrepancy in the estimates to increase in absolute terms as size decreases.

An important factor behind these findings is likely to be the growth of share repurchases in the UK which has been particularly evident since 1995. However, this data on precise firm-level share repurchases is not readily available and hence we are unable to include this in our analysis. If firms have been substituting dividends for share repurchases, as indeed it appears they have, then this would bias downwards the dividend growth rates and thus potentially explain why the dividend growth model estimates are substantially below those of the other models. It is also plausible that the reason why the disparity is largest for the smallest stocks is perhaps that these have particularly prompt and expeditious in their use of share repurchases. Although another trend apparent in both the UK (Ap Gwilym et al. (2004)) and US ( DeAngelo, DeAngelo and Skinner (2004)) is that of dividend concentration, whereby larger firms have tended to increase the amount of dividends they payout relative to earnings, whereas the reverse trend appears true of smaller firms.

It is possible that this is because there has been a shift in expected returns or expected fundamental growth. However, a shift in expected returns seems less likely given the earnings growth model, our alternative method for estimating expected equity premia, provides estimates consistent with the historical returns. However, we should also bear in mind that the earnings growth estimates are likely to be an upper limit on the equity premium that could be expected. This is because earnings can be managed, and the tendency for earnings management appears to have increased during our sample period (Berenson (2004)). We examine in more detail if there appear to be shifts in expected returns using structural break tests on valuation ratios in Chapter 5.4.2.

#### 5.3.1.3 PRE-DISCOVERY PERIOD: 1966-1984 (INCLUDING IMPACT OF MARKET CRASH)

The historical real equity premia for 1966-1984 is above that for the whole sample period across all size quintiles. A similar pattern is found in the expected equity premia implied by dividend growth and earnings growth and is apparent across all size quintiles. For instance for the largest firms (Q1) the equity premia for 1966-1984 is 7.32%, 7.71% and 4.65% according to the historical average, earnings growth and dividend growth methods respectively compared to 5.25%, 4.65% and 3.10% for the whole 1966-2002 sample. Similarly for the smallest firms (Q5) the premia for historical average, earnings growth and dividend growth were 17.34%, 17.41%, 14.65% over 1966-1984 but for 1966-2002 were 13.28%, 12.76% and 9.46%.

However, the differences between equity returns (which exclude the risk-free rate) were actually much closer. In fact, it seems that most of the difference between the two periods equity premia results can be attributed to performance of the average risk-free rate over the two periods considered, rather than the return earnt by equities. The risk-free rate, proxied for by the three-month treasury bill was actually negative in real terms over 1966-1984 averaging -0.50%, whilst over the whole sample period it was 1.61%. Consequently this can account for 2.11% of the difference in equity premia figures. If we simply compare the returns earnt by the size portfolios which ignores the risk-free rate, then we can examine if substantial discrepancies remain after this is accounted for. This reveals that for the largest firms (Q1) the returns earnt by all three measures are fairly similar for 1966-1984 and for 1966-2002. However, for the smaller quintiles from Q3 to Q5 there remains a substantial discrepancy between the return estimates for the different periods. This suggests for smaller firms there has been a change in the return characteristics between the two periods.

Has there been any change in the size premium? For the one-way sorted portfolios we measure the size premium as the difference in return between the smallest and largest size quintiles. The size premium was, on average larger over 1966-1984 than 1966-2002, being 10.02%, 9.71%, 10.00% according to historical average, earnings growth and dividend growth models in the earlier period and 8.03%, 8.11% and 6.36% for the whole sample period. Thus it appears the size premium on average did decline from 1985. This issue is explored further in the next section.

#### 5.3.1.4 POST-DISCOVERY PERIOD: 1985-2002

We view 1985 onwards as the period after which the size premium had been discovered and documented in the literature, since this was when Mario Levis' article on the UK Size Premium was published in a leading practitioner journal. Furthermore, this is several years after the phenomenon was first discovered in the US by Banz (1981) and Reinganum (1981). However, for the UK, Dimson and Marsh (1999) suggest that this might not be the case, and advocate a starting date after the Hoare-Govett smaller companies index was launched in 1987. Nevertheless, similar funds had been launched in the US several years earlier as well, famously the Dimensional Small Cap fund started in 1983. It seems rather unlikely that by 1985 UK investment professionals would be unaware of the 'size' anomaly. However, we do also discuss the results of Dimson and Marsh (1999) presenting new evidence and interpretation of their findings in Chapter 5.3.1.5.

The equity premia estimates for 1985-2002 are much lower than for the earlier period 1966-1984, across all size quintiles (or deciles). The historical average premia over 1985-2002 was 3% and 8.82% for the largest (Q1) and smallest (Q5) size quintiles respectively compared to 7.32% and 17.34% over 1966-1984. A similar pattern can be found for the expected equity premia. The earnings growth model figures were 1.34% (7.68%) for the largest (smallest) firms over 1985-2002 compared to 7.71% (17.41%) for 1966-1984. These results are qualitatively the same as for the dividend growth model which estimates 1.39% (4.65%) for the largest (smallest) firms over 1985-2002 compared to 3.81% (14.65%) for 1966-1984. These results add extra credence to the view that the equity premium has declined over recent years.

Although we find evidence that the equity premium has declined, the decline in equity returns is less pronounced. Since the risk-free rate has particularly low on average prior to 1984 and particularly high since 1985, then this is an important factor behind the fall in equity premia as suggested in 5.3.1.3. However equity returns themselves do appear to have fallen on average in all except the largest stocks (Q1). For the largest stocks the results suggest approximately similar returns during both periods.

The estimates of the equity premia from dividend growth are again further from the historical average than those from earnings growth over 1985-2002; as we also found over the earlier period 1966-1984 and over the whole sample period. The largest discrepancy between the historical average and either the dividend growth or earnings growth model is found for the smallest firms. Particularly for the dividend model estimates this discrepancy seems to increase as firm size falls. For the smallest firms (Q5) the difference between dividend and historical average estimates exceeds 5%, which is extremely large indeed. This is most likely due to recent changes in corporate payout policy. This finding is consistent with the work of DeAngelo et al. (2004) and Ap. Gwilym et al. (2004) who report that while a larger proportion of big companies are paying dividends, a lesser proportion of small firms are doing so. Payout ratios reported in Table 5.3 also support this view since prior to 1984 payout ratios were on average higher for smaller firms whereas since 1985 payout ratios have been about the same for firms in each size quintile.[52]

However, our results for the size premium suggest that this also has fallen over the recent period by all three measures. The size premium according to the historical average was 5.82% over 1985-2002 but 10.02% over 1966-1984, by earnings growth

[52] Since 1985 all size quintiles have average dividend payout ratios of about 55%. Prior to 1984 the average is about 60% for the largest size quintile but almost 70% for the largest size quintile.

was 6.34% over 1985-2002 and for 1966-1984 was 9.71%, whilst most striking is the decline by the dividend growth model which suggests it was only 2.42% over 1985-2002 but 10.00% for 1966-1984. The size premium estimates for the earnings growth and historical return models are broadly similar, both being around 6% p.a. and are within 0.52% of each other. However, there is a substantial discrepancy between the dividend growth model estimate of the size premium and either the historical average or the earnings growth model estimates. In fact the dividend growth model estimate of 2.42% is less than half that of either of the other models and almost 4% less than the historical average. As discussed in the previous section and as will be further discussed later in this chapter, we suggest the primary reason for this discrepancy is likely to be recent changes in corporate payout policy.

Nevertheless, the finding that a size premium remains following its discovery is important and contrary to some prior research based on a shorter time span. Black (1993) claims that market 'anomalies' vanish after they're discovered, Horowitz et al. (2000) provided some US empirical evidence substantiating this view for the size 'anomaly', whilst Dimson and Marsh (1999) suggested the size premium had actually gone into reverse in both the UK and the US following its discovery. Our results conflict with all these prior studies. We find a positive size premium is still very much in existence following its discovery, moreover our results suggest that a positive size premium can be expected and can be justified on the basis of the stronger relative growth of fundamentals in small companies compared to large companies. We suggest our use of a longer sample period provides a more reliable basis for analysis.

#### 5.3.1.5 PERFORMANCE OF 1989-1998: COMPARISON WITH DIMSON AND MARSH (1999)

Dimson and Marsh (1999) claimed that the size premium went into reverse following its discovery, both in the UK and the US. In their paper they propose a post-discovery period from 1989 onwards until the end of their sample in 1997. In order to compare our data with theirs we examine the 10-year period from 1989-1998. This is the 10-year period during our sample that large firms most strongly outperform small firms (using quintiles and arithmetic annual averages); the size premium is -5.93%. In fact only the second, 1988-1997 is the other, over which large firms outperform small firms. Therefore we find in our sample that for this period specifically, the 10 years from the late-eighties to the late-nineties that large firms did outperform small. However, this seems to be merely an exception to the rule that small firms outperform large.

Dimson and Marsh (1999) also found that such an outperformance of large firms could be supported by dividend growth. In this respect our results challenge theirs. We find that this reversal of the size premium was not expected nor can be justified by growth in fundamentals. In terms of dividend growth there seems to be very little variation in relative growth rates across the size quintiles. Specifically, the small firm quintile dividend premia was 3.26% only 0.55% below that of the largest quintile (3.81%), which cannot explain nor justify a historical return differential of 5.93% between the largest and smallest size quintiles. In terms of earnings growth there is variation across the quintiles however, this does not seem to conform to any particular trend. However, the earnings growth size premia for 1989-1998 was a positive if modest 2.10%, indicating the earnings profiles of small firms rose more rapidly than those of large firms. This is stark contrast to the 5.93% discount indicated by the average return. In this case it is the large firms average return which appears to be the main cause of this discrepancy since it exceeds that implied by earnings growth by almost 6%. In contrast for the other quintiles (Q2-Q5) average returns are less than those implied by earnings growth for 1989-1998.

Our three premia measures suggest three distinct conclusions about the size premia. The historical average indicates the actual size premium reversed being -5.93% was economically substantially negative. Our fundamental measures suggest a more modest premium / discount, the dividend model indicates a negative if minimal discount of -0.55% while the earnings model suggests a modest size premium of 2.10%. Therefore both the expected premia measures, dividend growth and earnings growth, point to the high levels of historical returns earnt by the largest firms not being supported by growth in fundamentals. This begs the question then, why did the largest firms enjoy such a high (relative) premium during this period? Is this phenomena anything other than a purely chance occurrence? We investigate these questions by examining structural breaks on the valuation ratios in chapter 5.4.2.

#### 5.3.2.1 TWO WAY SORTED SIZE-VALUE PORTFOLIOS:

In this section we examine the size premium once value has been controlled for. This is an important control since there does appear to be a relationship between firm size and value. Specifically we find a tendency for size and earnings-price to be negatively correlated. This can be seen from the descriptive statistics pertaining to one way sorted size portfolios since the smaller quintiles tend to have higher earnings-price ratios on average for the whole sample period than the larger size quintiles. A similar pattern can be seen in the dividend-price ratios. These observations can be paralleled to the comments of Dimson, Nagel and Quigley (2003) who also report that size and value are negatively correlated in the UK. As discussed in the data and methodology section we use the earnings-price ratio as our measure of value, which is a commonly used measure of value in the extant literature.

The Fama-French (1993) small minus big (SMB) portfolio is not directly comparable to our measures of the size premium from the one-way size sort. The Fama-French style size sort is dependent on whether the firm is in the largest 50% of the sample or the smallest 50%, whereas for the one-way sort we focussed upon the difference between largest and smallest quintiles (20% of observations). Therefore in the interests of comparability for this section, we also report the results from a purely one-way sort on size defined as the smallest 50% - largest 50%, which should act to highlight the impact that controlling for value has upon our equity premia estimates. This one-way sorted small minus big portfolio is referred to as 1WSMB.

#### 5.3.2.2 FULL SAMPLE PERIOD 1966-2002

Our results find a strong positive equity premium in all size/value sorted portfolios over 1966-2002. The equity premium monotonically increases with earnings-price groupings. The equity premium is always larger for the smaller firms relative to the large firms when value is held constant. For instance, the small size-low earnings-price portfolio (SL) historical average premia of 8.14% p.a. while the large size-low earnings-price portfolio (BL) earns 4.54% p.a. As one would expect given the extensive literature on the properties of size and value returns, the small size-high earnings-price portfolio earns the highest historical premia of all, 13.40%. The second highest return is earnt by the large size-high earnings-price portfolio, which is 11.11%. This is further evidence suggestive that the relationship between size and returns is pervasive, in this case to controlling for value.

Moreover, the historical size premium measured by SMB, is 3.41%, which is considerably smaller, less than half the 7.48% size premium measured as the difference between the extreme quintile portfolios (Q5-Q1). However, since the size breakpoints are in different positions for the two portfolios these figures, cannot actually be directly compared. In fact, the single sort premium on size using the FF breakpoints is 3.97% (for 1WSMB), indicating that only a small portion of the overall size premium, 0.56%, can be attributed to the differing value characteristics of the portfolios. In other words the overwhelming majority of the single size-sort size premium seems due to the difference in size between the portfolios, rather than simply be explained away be the tendency of small firms to have higher earnings-price ratios.

In terms of the expected size premium over 1966-2002, this also tends to be positive once value is controlled for. For the earnings growth measure of the equity premia this is positive across value categories. Overall the SMB size premium according to this measure is 2.82%, which is of similar magnitude to the 3.41% historical average premium. However the earnings growth expected equity premia between small and large firms varies to a degree across value categories. The premium for the highest earnings-price ratios firms is 2.01%, but is higher for the medium value firms being 3.76% and is 2.68% for the lowest earnings-price ratio firms. Overall the earnings growth SMB premium of 2.82% is smaller than the 4.22% expected premium of 1WSMB which fails to account for differences in value .

## TABLE 5.5: TWO-WAY SIZE SORTED PORTFOLIO ESTIMATES OF FUNDAMENTAL GROWTH RATES AND VALUATION RATIOS (1966-2002)

Panel A: Valuation Ratio and Fundamental Growth Rates 1966-2002

| | Sample | Inf | $F_t$ | $DY_t$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-2002 | 6.97% | 1.61% | 3.76% | 3.40% | 5.05% | 67.00% | -0.32% | 3.98% | 5.99% |
| B/L | 1966-2002 | 6.97% | 1.61% | 3.44% | 3.20% | 5.36% | 61.59% | 1.68% | 1.62% | 2.71% |
| S/M | 1966-2002 | 6.97% | 1.61% | 5.59% | 5.03% | 8.11% | 63.86% | 2.17% | 5.12% | 6.94% |
| B/M | 1966-2002 | 6.97% | 1.61% | 4.75% | 4.42% | 7.63% | 60.68% | 0.53% | 2.20% | 3.46% |
| S/H | 1966-2002 | 6.97% | 1.61% | 6.79% | 6.09% | 10.75% | 58.25% | 4.52% | 6.76% | 8.22% |
| B/H | 1966-2002 | 6.97% | 1.61% | 6.13% | 5.58% | 10.50% | 55.06% | 3.69% | 5.41% | 6.58% |
| SMB | 1966-2002 | 0.00% | 0.00% | 0.37% | 0.44% | 0.14% | 3.92% | 0.15% | 2.21% | 2.80% |
| 1WSMB | 1966-2002 | 0.00% | 0.00% | 0.80% | 0.77% | 0.86% | 2.96% | 2.25% | 3.28% | 3.03% |

Panel B: Valuation Ratio and Fundamental Growth Rates 1966-2002 spike adjust

| | Sample | Inf | $F_t$ | $DY_t$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-2002 | 6.97% | 1.61% | 3.76% | 3.40% | 5.05% | 67.00% | -0.33% | 3.97% | 5.26% |
| B/L | 1966-2002 | 6.97% | 1.61% | 3.44% | 3.20% | 5.36% | 61.59% | 1.68% | 1.62% | 1.40% |
| S/M | 1966-2002 | 6.97% | 1.61% | 5.59% | 5.03% | 8.11% | 63.86% | 2.17% | 5.12% | 5.75% |
| B/M | 1966-2002 | 6.97% | 1.61% | 4.75% | 4.42% | 7.63% | 60.68% | 0.51% | 2.12% | 2.14% |
| S/H | 1966-2002 | 6.97% | 1.61% | 6.79% | 6.09% | 10.75% | 58.25% | 4.50% | 6.62% | 6.74% |
| B/H | 1966-2002 | 6.97% | 1.61% | 6.13% | 5.58% | 10.50% | 55.06% | 3.68% | 5.39% | 4.80% |
| SMB | 1966-2002 | 0.00% | 0.00% | 0.37% | 0.44% | 0.14% | 3.92% | 0.16% | 2.19% | 3.14% |
| 1WSMB | 1966-2002 | 0.00% | 0.00% | 0.80% | 0.77% | 0.86% | 2.96% | 2.25% | 3.25% | 3.36% |

Panel C: 1966-1984 spike adjust

| | Sample | Inf | $F_t$ | $DY_t$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-1984 | 9.76% | -0.50% | 5.08% | 4.55% | 5.93% | 80.34% | 0.39% | 4.40% | 4.46% |
| B/L | 1966-1984 | 9.76% | -0.50% | 4.19% | 3.84% | 6.20% | 64.67% | -1.06% | -0.85% | 1.47% |
| S/M | 1966-1984 | 9.76% | -0.50% | 6.71% | 5.94% | 8.82% | 71.30% | 3.28% | 4.09% | 5.76% |
| B/M | 1966-1984 | 9.76% | -0.50% | 5.38% | 4.99% | 8.57% | 63.11% | -1.16% | 1.57% | 1.49% |
| S/H | 1966-1984 | 9.76% | -0.50% | 7.70% | 6.70% | 11.39% | 61.81% | 4.85% | 7.56% | 7.46% |
| B/H | 1966-1984 | 9.76% | -0.50% | 6.67% | 5.96% | 11.33% | 56.13% | 2.38% | 6.07% | 4.20% |
| SMB | 1966-1984 | 0.00% | 0.00% | 0.73% | 0.80% | 0.01% | 9.85% | 2.79% | 3.09% | 3.51% |
| 1WSMB | 1966-1984 | 0.00% | 0.00% | 1.05% | 1.05% | 0.75% | 7.28% | 3.50% | 2.59% | 3.92% |

Panel D: 1988-1998

| | Sample | Inf | $F_t$ | $DY_t$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| S/L | 1989-1998 | 4.33% | 3.78% | 2.50% | 2.49% | 4.32% | 57.45% | 1.21% | -0.63% | 0.58% |
| B/L | 1989-1998 | 4.33% | 3.78% | 3.00% | 2.69% | 4.51% | 60.40% | 11.33% | 4.96% | 8.33% |
| S/M | 1989-1998 | 4.33% | 3.78% | 4.51% | 4.47% | 7.61% | 60.05% | 0.96% | 1.34% | -0.66% |
| B/M | 1989-1998 | 4.33% | 3.78% | 4.30% | 3.92% | 6.32% | 62.50% | 4.40% | 2.77% | 6.01% |
| S/H | 1989-1998 | 4.33% | 3.78% | 5.39% | 5.57% | 9.84% | 57.19% | 0.02% | -1.77% | -2.93% |
| B/H | 1989-1998 | 4.33% | 3.78% | 5.45% | 5.35% | 9.30% | 57.34% | 6.30% | 3.77% | 1.28% |
| SMB | 1989-1998 | 0.00% | 0.00% | 0.11% | 0.19% | 0.55% | -1.85% | -6.61% | -4.19% | -6.21% |
| 1WSMB | 1989-1998 | 0.00% | 0.00% | 0.64% | 0.50% | 1.13% | -2.19% | -1.70% | -0.15% | -7.21% |

Panel E: 1985-2002

| | Sample | Inf | $F_t$ | $DY_t$ | $D_t/P_t$ | $Y_t/P_t$ | $D_t/Y_t$ | $GD_t$ | $GY_t$ | $GP_t$ |
|---|---|---|---|---|---|---|---|---|---|---|
| S/L | 1985-2002 | 3.88% | 3.92% | 2.35% | 2.20% | 4.10% | 52.95% | -1.09% | 3.52% | 6.10% |
| B/L | 1985-2002 | 3.88% | 3.92% | 2.63% | 2.53% | 4.41% | 58.95% | 4.57% | 4.22% | 1.33% |
| S/M | 1985-2002 | 3.88% | 3.92% | 4.33% | 4.02% | 7.25% | 56.22% | 0.99% | 6.20% | 5.75% |
| B/M | 1985-2002 | 3.88% | 3.92% | 4.06% | 3.81% | 6.53% | 58.87% | 2.27% | 2.70% | 2.83% |
| S/H | 1985-2002 | 3.88% | 3.92% | 5.73% | 5.39% | 9.91% | 54.70% | 4.13% | 5.62% | 5.98% |
| B/H | 1985-2002 | 3.88% | 3.92% | 5.54% | 5.17% | 9.44% | 55.00% | 5.05% | 4.68% | 5.44% |
| SMB | 1985-2002 | 0.00% | 0.00% | -0.04% | 0.03% | 0.30% | -2.98% | -2.62% | 1.25% | 2.74% |
| 1WSMB | 1985-2002 | 0.00% | 0.00% | 0.48% | 0.43% | 0.95% | -1.60% | 0.93% | 3.96% | 2.76% |

## TABLE 5.6: TWO-WAY SORTED SIZE PORTFOLIO ESTIMATES OF FUNDAMENTAL GROWTH RATES AND VALUATION RATIOS (1966-2002)

Panel A: Equity Return and Equity Premia Estimates 1966-2002

| | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-2002 | 3.44% | 7.74% | 9.75% | 1.83% | 6.13% | 8.14% | 6.31% | 2.01% |
| B/L | 1966-2002 | 5.12% | 5.05% | 6.14% | 3.51% | 3.45% | 4.54% | 1.02% | 1.09% |
| S/M | 1966-2002 | 7.76% | 10.71% | 12.53% | 6.15% | 9.10% | 10.92% | 4.77% | 1.82% |
| B/M | 1966-2002 | 5.28% | 6.94% | 8.21% | 3.67% | 5.34% | 6.60% | 2.93% | 1.26% |
| S/H | 1966-2002 | 11.30% | 13.55% | 15.01% | 9.70% | 11.94% | 13.40% | 3.71% | 1.46% |
| B/H | 1966-2002 | 9.82% | 11.54% | 12.71% | 8.21% | 9.93% | 11.11% | 2.89% | 1.17% |
| SMB | 1966-2002 | 0.76% | 2.82% | 3.41% | 0.76% | 2.82% | 3.41% | 2.65% | 0.59% |
| 1S-B | 1966-2002 | 3.19% | 4.22% | 3.97% | 3.19% | 4.22% | 3.97% | 0.78% | -0.25% |

Panel B: Equity Return and Equity Premia Estimates 1966-2002 spike adjust

| | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-2002 | 3.43% | 7.73% | 9.02% | 1.83% | 6.12% | 7.41% | 5.59% | 1.29% |
| B/L | 1966-2002 | 5.12% | 5.05% | 4.84% | 3.51% | 3.44% | 3.23% | -0.28% | -0.21% |
| S/M | 1966-2002 | 7.76% | 10.71% | 11.34% | 6.15% | 9.10% | 9.74% | 3.59% | 0.64% |
| B/M | 1966-2002 | 5.25% | 6.86% | 6.89% | 3.65% | 5.26% | 5.28% | 1.64% | 0.02% |
| S/H | 1966-2002 | 11.28% | 13.40% | 13.53% | 9.68% | 11.80% | 11.92% | 2.24% | 0.13% |
| B/H | 1966-2002 | 9.81% | 11.53% | 10.94% | 8.21% | 9.92% | 9.33% | 1.12% | -0.59% |
| SMB | 1966-2002 | 0.53% | 2.57% | 3.51% | 0.53% | 2.57% | 3.51% | 2.98% | 0.94% |
| 1S-B | 1966-2002 | 3.05% | 4.05% | 4.16% | 3.05% | 4.05% | 4.16% | 1.11% | 0.10% |

Panel C: 1966-1984 spike adjust

| | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| S/L | 1966-1984 | 5.47% | 9.47% | 9.54% | 5.97% | 9.98% | 10.04% | 4.07% | 0.06% |
| B/L | 1966-1984 | 3.14% | 3.34% | 5.66% | 3.64% | 3.84% | 6.17% | 2.52% | 2.32% |
| S/M | 1966-1984 | 9.99% | 10.80% | 12.47% | 10.50% | 11.31% | 12.97% | 2.47% | 1.66% |
| B/M | 1966-1984 | 4.22% | 6.96% | 6.88% | 4.72% | 7.46% | 7.38% | 2.65% | -0.08% |
| S/H | 1966-1984 | 12.55% | 15.26% | 15.16% | 13.05% | 15.76% | 15.67% | 2.62% | -0.10% |
| B/H | 1966-1984 | 9.06% | 12.74% | 10.88% | 9.56% | 13.25% | 11.38% | 1.82% | -1.87% |
| SMB | 1966-1984 | 3.52% | 3.82% | 4.24% | 3.52% | 3.82% | 4.24% | 0.72% | 0.42% |
| 1S-B | 1966-1984 | 4.55% | 3.63% | 4.97% | 4.55% | 3.63% | 4.97% | 0.42% | 1.33% |

Panel D: 1989-1998

| | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| S/L | 1989-1998 | 3.71% | 1.87% | 3.08% | -0.07% | -1.91% | -0.70% | -0.63% | 1.22% |
| B/L | 1989-1998 | 14.33% | 7.96% | 11.33% | 10.55% | 4.18% | 7.55% | -3.00% | 3.37% |
| S/M | 1989-1998 | 5.47% | 5.85% | 3.85% | 1.70% | 2.07% | 0.07% | -1.63% | -2.00% |
| B/M | 1989-1998 | 8.71% | 7.07% | 10.31% | 4.93% | 3.30% | 6.53% | 1.60% | 3.23% |
| S/H | 1989-1998 | 5.41% | 3.62% | 2.46% | 1.63% | -0.15% | -1.32% | -2.95% | -1.16% |
| B/H | 1989-1998 | 11.75% | 9.22% | 6.73% | 7.97% | 5.44% | 2.96% | -5.02% | -2.48% |
| SMB | 1989-1998 | -6.73% | -4.30% | -6.33% | -6.73% | -4.30% | -6.33% | 0.41% | -2.02% |
| 1S-B | 1989-1998 | -1.61% | -0.07% | -7.12% | -1.61% | -0.07% | -7.12% | -5.51% | -7.05% |

Panel E: 1985-2002

| | Sample | RDt | RYt | Rt | RXDt | RXYt | RXt | RXt - RXDt | RXt - RXYt |
|---|---|---|---|---|---|---|---|---|---|
| S/L | 1985-2002 | 1.26% | 5.87% | 8.45% | -2.66% | 1.95% | 4.53% | 7.19% | 2.58% |
| B/L | 1985-2002 | 7.20% | 6.86% | 3.96% | 3.29% | 2.94% | 0.05% | -3.24% | -2.89% |
| S/M | 1985-2002 | 5.32% | 10.52% | 10.08% | 1.40% | 6.61% | 6.16% | 4.76% | -0.45% |
| B/M | 1985-2002 | 6.33% | 6.76% | 6.89% | 2.41% | 2.84% | 2.97% | 0.56% | 0.14% |
| S/H | 1985-2002 | 9.86% | 11.35% | 11.71% | 5.94% | 7.43% | 7.79% | 1.85% | 0.36% |
| B/H | 1985-2002 | 10.59% | 10.22% | 10.98% | 6.67% | 6.30% | 7.06% | 0.39% | 0.76% |
| SMB | 1985-2002 | -2.56% | 1.30% | 2.80% | -2.56% | 1.30% | 2.80% | 5.36% | 1.50% |
| 1S-B | 1985-2002 | 1.37% | 4.40% | 3.20% | 1.37% | 4.40% | 3.20% | 1.84% | -1.19% |

In terms of the dividend growth measure of the SMB expected equity premia this is positive overall, but of small magnitude being just 0.76%. The dividend model results suggest that once value is controlled for overall then the size premium becomes much smaller, since by the SMB method it is 0.76% compared to the 3.19% implied by 1WSMB. However, this doesn't provide a full overview of what is found across the value groupings, since the difference between small and large firm performance appears dependent upon the value classification of the portfolio.

In actual fact the expected size premium varies even more when measured using dividend growth than when earnings growth was used once value is controlled for. For high earnings-price firms the size premium is expected to be 1.51%, whilst for medium earnings-price firms it is 2.58%. However, for the lowest earnings-price firms it is negative being -1.68%, thus amongst glamour stocks large corporations actually have higher expected premia than small firms. Therefore although expected SMB size premium appears much smaller by the dividend measure (only 0.76%), a more detailed examination of the data across value groupings suggests that the performance of big and small companies varied substantially over 1966-2002.

Why do the patterns we find exist? What appears to be causing them? Why does the small-low portfolio have such a low dividend model equity premia relative to the much higher values found by the earnings model and the historical average model. We now turn to look at the impact of the 1974 market crash on the results and then a more detailed sub-period analysis.

### 5.3.2.3 IMPACT OF 1974 STOCK MARKET CRASH

As mentioned in the previous section relating to the one-way sort on size, the 1974 stock market crash has the potential to substantially impact upon our results. We therefore examine if the main trends found in the previous section are robust to the neutralisation of this crash in the current section using the same method to correct for this as in our second empirical chapter for industry groupings. Similar to our results in the Chapter 4, we also find for size portfolios that the estimated values of historical returns are substantially affected and biased upwards by the 1974 market crash.

Table 5.6 Panel C demonstrates the adjustment increases the SMB historical average premium from 3.41% to 3.51%; this is only a marginal change in the size premium after the 1974 crash is adjusted for. This finding doesn't appear to be driven by the value sort, since the 1WSMB premium also rises marginally by 0.19%, from 3.97% to 4.16%. These results are contrary to those find according to the one-way size premium between the extreme quintiles (Q5-Q1), which suggested the size premium fell after the 1974 crash was adjusted for. Consequently these results for the SMB and 1WSMB portfolios are more favourable towards the hypothesis that small firms are more sensitive to market crashes than large firms and such an economic explanation for the size premium. However, overall, given both sets of results, we find mixed evidence that the size premium could be a premium for the higher risk of holding small firms if there is an extreme movement in the market.

The expected estimates of the equity premia are also affected by the crash. However, they are also only marginally affected, but in contrast to the historical average estimates these estimates of the size premium fall rather than increase. The expected SMB earnings growth premia falls from 2.82% to 2.57% and from 0.76% to

0.53% for SMB dividend growth premia. Slightly smaller drops are found for the 1WSMB premia from 4.22% to 4.05% for earnings growth whilst for dividend growth the fall was from 3.19% to 3.05%. Consequently in terms of fundamentals it appears that large firms are more affected than small companies when there is a large adverse stock market shock.

The net impact of these results on the difference between SMB equity premia estimates is that they increase from 0.59% to 0.94% between the historical average and earnings growth method and also increase from 2.65% to 2.98% between the historical average and dividend growth method. For 1WSMB equity premia there is also an increase for the dividend growth method from 0.78% to 1.11%. However, 1WSMB earnings growth premia the discrepancy changes from -0.25% to 0.10% and so the absolute difference between the estimates actually falls. Thus for the overview of size premia it appears that these generally increase once the 1974 crash is removed. Is this also true of the individual portfolios?

In actuality the reverse is true for the 6 size-value portfolios. When the 1974 crash is neutralised then for each portfolio, and whether by the earnings growth or dividend growth measure then the absolute discrepancy between the estimates falls. However, and importantly, the dividend growth measure remains a considerable distance from the historical average across almost all portfolios. Only for large firms with low earnings-price ratios is it within 1% of the historical average. In contrast the earnings growth model has a discrepancy greater than 1% for only one portfolio, the small-low earnings-price group. The earnings growth model estimates for the other portfolios are also close to the historical average. Consequently there is disagreement between our measures of expected returns as to whether or not the historical average was close to what could have been expected. As previously discussed an important factor that could impact upon the dividend growth measure is the impact of recent changes in dividend payout policy.

### 5.3.2.4 PRE-DISCOVERY PERIOD: 1966-1984 (INCLUDING IMPACT OF MARKET CRASH)

Similarly to the results found from the one-way sort, the historical equity premia for 1966-1984 for each and every size-value portfolio is greater than the whole sample period value. Parallel results are found in the expected equity premia implied by dividend growth and earnings growth and is apparent across all size-value portfolios. For instance for the big-high portfolio the equity premia for 1966-1984 is 9.56%, 13.25% and 11.38% according to the historical average, earnings growth and dividend growth methods respectively compared to 8.21%, 9.92% and 9.33% for the whole 1966-2002 sample. Similarly for the small-high portfolio the premia for historical average, earnings growth and dividend growth were 13.05%, 15.76%, 15.67% over 1966-1984 but for 1966-2002 were 9.68%, 11.80% and 11.92%.

However, again paralleling the one-way sort results, the differences between equity returns (which exclude the risk-free rate) were actually much closer. In fact, it seems that most of the difference between the two periods equity premia results can be attributed to performance of the average risk-free rate over the two periods considered, rather than the return earnt by equities. The risk-free rate was negative in real terms over 1966-1984 averaging -0.50%, whilst over the whole sample period it was 1.61%. Consequently this can account for 2.11% of the difference in equity premia figures.

Turning our attention to the scale of the size premium, the SMB size premium is, on average larger over 1966-1984 than 1966-2002 according to all three models. For 1966-1984 the size premium is 4.24%, 3.82%, 3.52% according to historical average, earnings growth and dividend growth models, whilst for the whole sample period the premium is 3.51%, 2.57%, 0.53%. The 1WSMB also tended to be larger over 1966-1984 than 1966-2002; it is 4.97%, 3.63%, 4.55% according to historical average, earnings growth and dividend growth models in the earlier period and 4.16%, 4.05%, 3.05% for the whole sample period. Here the earnings-growth premia is larger for the earlier period than the latter period although the reverse is true of the other measures. Nevertheless, the 1WSMB grouping suggests at best a marginally lower size premium for the whole sample period than 1966-1984. However, the two-way sort makes any decline in the size premium more pronounced. That is if value is controlled for then there does seem to have been a drop in the size premium that is somewhat obscured if just a one-way sort is used with the median size breakpoint.

### 5.3.2.5 POST-DISCOVERY PERIOD: 1985-2002

As discussed in the Chapter 5.3.1.4 we view 1985 onwards as the period after which the size premium had been discovered and documented in the literature. The equity premia estimates for 1985-2002 are much lower than for the earlier period 1966-1984, across all size quintiles (or deciles). The historical average premia for the big-high (BH), small-high (SH) portfolios were 7.79% and 7.06% over 1985-2002 compared to 15.67% and 11.38% over 1966-1984. For the big-low (BL) and small-low (SL) portfolios the premia for 1985-2002 were 4.53% and 0.05% substantially less than the 10.04% and 6.17% earnt over 1966-1984.

A similar pattern can be found for the expected equity premia. The earnings growth model figures were 7.43% (6.30%) for the BH (LH) firms over 1985-2002 are lower compared to 13.25% (15.76%) for 1966-1984. These results are qualitatively the same as for the dividend growth model which estimates 5.94% (6.67%) for the BH (LH) portfolio over 1985-2002 are also less than the 9.56% (13.05%) for 1966-1984. The earnings growth model figures were 2.94% (1.95%) for the BL (SL) firms over 1985-2002 are lower when compared to 3.84% (9.98%) for 1966-1984. These results are qualitatively similar as for the dividend growth model which estimates 3.20% (-2.66%) for the BL (SL) portfolio over 1985-2002 less than the 3.64% (5.97%) for 1966-1984. These results add extra credence to the view that the equity premium has declined over recent years.

The estimates of the equity premia from dividend growth are again further from the historical average than those from earnings growth over 1985-2002. As we also found over the earlier period 1966-1984 over the whole sample period. The largest discrepancy between the historical average and either the dividend growth or earnings growth model is found for the SL portfolio. More generally, the lowest earnings-price groupings the discrepancies are largest. Particularly for the dividend model estimates this discrepancy seems to increase as the earnings-price ratio grouping falls. However, for the BL portfolio the difference is negative and substantial economically (-3.24%) suggesting expected returns were appreciably above historical returns. Whereas for the SL portfolio the difference is positive and substantial economically (7.19%). There is also positive and of large magnitude (4.76%) for the small-medium value (SM) portfolio. As previously articulated, this is most likely due to recent changes in corporate payout policy. These findings are consistent with the work of DeAngelo et al. (2004) who report that while a larger proportion of big companies are paying dividends, a lesser proportion of small firms are doing so.

However, our results for the size premium suggest that this also has fallen over the recent period by all three measures. The SMB size premium according to the historical average was 2.80% over 1985-2002 but 4.24% over 1966-1984, by earnings growth 1.30% over 1985-2002 and for 1966-1984 3.82%, whilst most striking is the decline by the dividend growth model which suggests it was -2.56% over 1985-2002 but 3.52% for 1966-1984. The size premium estimates for the earnings growth and historical return models are broadly similar for the earlier period, both being around 4% p.a. and are within 0.42% of each other. There is a difference of 1.50% over 1985-2002 though, but both suggest a substantial fall. However, there is a substantial discrepancy between the dividend growth model estimate of the size premium and either the historical average or the earnings growth model estimates. While the other models suggest a modest positive premium, in fact the dividend growth model estimate is negative for 1985-2002 -2.56% which is more than 5% less than that implied by the historical average. A negative size premium, however, is something that has been advocated in the literature by Dimson and Marsh (1999) and something we shall return to in the next section. As discussed in the previous section and as will be further discussed later in this chapter, we suggest the primary reason for this discrepancy is likely to be recent changes in corporate payout policy.

Our results for the one-way median break-point size premium also suggests that the historical average premium fell over the most recent period. The 1WSMB size premium according to the historical average was 3.20% over 1985-2002 but 4.97%

over 1966-1984. However, the earnings growth premia estimate was 4.40% over 1985-2002 and 3.63% for 1966-1984, thus this was actually slightly higher during the later period. There was a substantial decline in dividend growth model premia estimate from 4.55% over 1966-1984 to 1.37% over 1985-2002, however this remained positive for the latter period.

The latter period, 1985-2002 appears to be when the divergences between the estimates occur. For the former period, 1966-1984 there seems to be a consensus amongst the estimates that the SMB size premium was 3.52-4.24% and the 1WSMB premium was 3.63-4.97%. Particular once value is controlled for the (SMB) premium falls within a relatively narrow range. Over 1985-2002 there seems to be substantial discrepancies between the estimates. The historical premium by both methods was around 3%. However, the dividend growth model estimates were both substantially below this, for SMB the premia was negative to the tune of -2.56%. While the earnings growth model estimate for SMB is 1.50% below the historical equity premia for 1985-2002, its estimate for 1WSMB is 1.20% above, therefore both appear to deviate some distance from the historical average, but is unclear as to what is most likely to be driving those findings.

Here we find that the ex-post size premium remains positive following its discovery is important and contrary to some prior research based on a shorter time span. However, we do find the dividend growth model provides estimates of premia that are either negative or small for the post-discovery period as suggested by Dimson and Marsh (1999) and Black (1993) respectively. The question for the dividend model is are these results driven simply by arbitrary managerial decisions vis-à-vis payout policy or real underlying economic conditions. Our use of the earnings growth model, provides a suggestion that for the earnings model at least a positive, if perhaps modest, size premium is implied for the latter period. Although, the magnitude of this is substantially smaller than 1966-1984 once value is controlled for.

### 5.3.2.6 PERFORMANCE OF 1989-1998: COMPARISON WITH DIMSON AND MARSH (1999)

Dimson and Marsh (1999) claimed that the size premium went into reverse following its discovery, both in the UK and the US. In their paper they propose a post-discovery period from 1989 onwards until the end of their sample in 1997. For comparability we examine the 10-year period from 1989-1998, which is the 10-year period that provides the strongest evidence in favour of their hypothesis.

Similarly to our results from the one-way quintile sort on size we find that large firms did outperform small firms over the period 1989-1998 when the median break point is used. The historical average size premium was -6.33% by the SMB measure and -7.12% by the 1WSMB method. Therefore the margin by which large firms outperformed small during this 10-year period appears to be substantial economically since it is in excess of 6%. Furthermore, the impact of controlling for value on the historical average size premium appears slight, causing difference between size portfolio returns to be reduced by just 0.79%.

From the one-way size-quintile sort in the previous section we found that this outperformance of large firms in terms of historical returns did not translate into outperformance in terms of fundamentals and the implied equity premia estimates. The results for the 1WSMB expected size premium are in line with those conclusions since premia estimates are fairly close to zero being -0.07% and -1.61% respectively for the earnings growth and dividend growth method. However, this view changes when value is controlled for. A SMB expected size premium is -4.30% and -6.73% for the earnings growth and dividend growth methods respectively. This suggests that once value is controlled for then the historical return during this ten-year period was essentially supported by fundamentals. The difference in returns between firms of similar value characteristics over 1989-1998 can be largely explained by the difference in growth rates of dividends and earnings.

## 5.4 EXPLAINING UK EQUITY RETURNS

### 5.4.1 WHAT CAUSES THE DISCREPANCIES WE FOUND IN UK EQUITY PREMIA?

Our expected return models, particularly the dividend growth model, often produce estimates rather different from the historical average model. In this section we attempt to uncover what has caused these discrepancies. Our approach is based on the Campbell (1991) return decomposition, which posits that a deviation of actual returns from expectations can be caused by either:

A) the expected future growth of fundamentals being unusually high.

B) a decline in expected unconditional stock returns during the sample period.

#### 5.4.1.1 ARE POST 2000 EXPECTED DIVIDEND AND EARNINGS GROWTH RATES UNUSUALLY HIGH?

It has been argued we have entered a new economic era, which has enabled higher rates of economic growth to be attained. One claim is that the ever increasing pace of technological developments has facilitated more rapid productivity growth (Jagannathan et al, 2001). An alternative argument is that increasing globalisation as witnessed by growing moves towards a truly globally integrated economic system in which resources can be allocated more efficiently due to previous barriers being removed and in which companies are able to locate production internationally in order to minimise costs. A final assertion is that substantial declines in inflation during the latter part of the $20^{th}$ Century in many developed economies has set the footing for more stable and higher economic growth in the future, economic policymakers have argued. These three factors have lead to hopes that higher levels of economic growth can be achieved and sustained long into the future.

However, if higher future growth rates had not been anticipated or expected at the beginning of our sample period then this would lead to unexpected capital gains for those who invested in that portfolio. These unexpected capital gains will be realised as the potential for extended periods of high economic growth became known to investors and incorporated into their expectations. We examine the predictability of the dividend growth rate and the earnings growth rate from variables known one year in advance in a similar manner as Fama-French (2002) and then proceed to examine if end of sample forecasts are different from the norm.

### 5.4.1.2 IN-SAMPLE PREDICTABILITY USING ALL POSSIBLE CANDIDATE VARIABLES

Initially we include all the available variables which we believe could have predictability over future fundamental growth rates. We use: i) the dividend-price or earnings-price ratio, ii) the dividend-payout ratio and iii) the consumption-dividend or consumption-earnings ratio. These have all been documented in the literature to have explanatory power over future returns. Here we assess if they are able to predict future growth rates of earnings or dividends. We also include prior fundamental growth rates since it is quite conceivable the previous time-series data will contain information about the future series and particularly for dividends the case has been made that we should expect some persistence in the time-series.

$$\begin{aligned} &GD_t = \alpha + \beta_1.(D_{t-1}/P_{t-1}) + \beta_2.D_{t-1}/Y_{t-1} + \beta_3.GD_{t-1} + \beta_4.CYDT_{i,t-1} + \varepsilon_t \\ (43)\quad &GY_t = \alpha + \beta_1.(Y_{t-1}/P_{t-1}) + \beta_2.D_{t-1}/Y_{t-1} + \beta_3.GY_{t-1} + \beta_4.CDDT_{i,t-1} + \varepsilon_t \end{aligned}$$

Table 5.7 reports the results of regression (43). Panel A indicates that for one-year dividend growth that although most of the dependent variables predict dividend growth with the correct sign, relatively few are statistically significant. For example the dividend-price ratio has the correct sign in all but two of the regressions, however it is only statistically significant in 3 out of 14 cases. The exceptions seem to be for the consumption-dividend ratio, which is significant in 9 of 14 cases and lagged dividend growth, which is significant in 8 of 14 cases. Given that for most of the regressions $R^2$ is above 0.2 and relatively few coefficients are individually significant, the classic symptoms of multicollinearity are apparent in Panel A. This suggests that a more parsimonious specification might enable us to uncover the true nature of the relationship between dividend growth and the individual variables.

## TABLE 5.7: FUNDAMENTAL GROWTH PREDICTABILITY WITH ALL VARIABLES

Panel A: One-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $D_{t-1}/P_{t-1}$ | $GD_{t-1}$ | $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GD_t$ | 1966-2002 | 0.10 | -0.06 | -1.52 | 0.37 | 0.01 | 0.1204 |
| | | (0.94) | (0.37) | (1.64) | (2.19) | (1.69) | |
| Q2 $GD_t$ | 1966-2002 | 0.09 | -0.12 | -0.06 | 0.67 | 0.02 | 0.4110 |
| | | (0.99) | (0.99) | (0.08) | (4.25) | (5.45) | |
| Q3 $GD_t$ | 1966-2002 | 0.14 | -0.13 | -0.88 | 0.55 | 0.02 | 0.3290 |
| | | (1.55) | (1.07) | (1.88) | (3.29) | (3.74) | |
| Q4 $GD_t$ | 1966-2002 | 0.10 | -0.17 | 0.43 | 0.61 | 0.02 | 0.3534 |
| | | (0.79) | (1.04) | (0.56) | (3.57) | (4.36) | |
| Q5 $GD_t$ | 1966-2002 | 0.05 | -0.05 | 0.41 | 0.39 | 0.03 | 0.1544 |
| | | (0.43) | (0.40) | (0.34) | (2.64) | (3.02) | |
| QPREM $GD_t$ | 1966-2002 | -0.04 | 0.00 | -1.24 | 0.05 | 0.00 | -0.0533 |
| | | (1.31) | (0.13) | (0.46) | (0.36) | (1.81) | |
| SL $GD_t$ | 1966-2002 | 0.07 | -0.09 | -0.10 | 0.11 | 0.00 | -0.0306 |
| | | (0.54) | (0.49) | (0.07) | (0.93) | (1.49) | |
| BL $GD_t$ | 1966-2002 | 0.27 | -0.23 | -3.33 | -0.08 | 0.00 | 0.2048 |
| | | 1.49 | (0.97) | (2.06) | (0.49) | (2.17) | |
| SM $GD_t$ | 1966-2002 | 0.05 | -0.02 | -0.47 | 0.40 | 0.01 | 0.0730 |
| | | 0.51 | (0.14) | (0.74) | (2.40) | (2.12) | |
| BM $GD_t$ | 1966-2002 | 0.41 | -0.32 | -4.71 | 0.29 | 0.01 | 0.4284 |
| | | (3.44) | (2.39) | (4.80) | (2.09) | (2.63) | |
| SH $GD_t$ | 1966-2002 | 0.21 | -0.20 | -1.08 | 0.37 | 0.02 | 0.2965 |
| | | (1.68) | (1.16) | (0.98) | (2.67) | (3.55) | |
| BH $GD_t$ | 1966-2002 | 0.35 | -0.32 | -2.60 | 0.20 | 0.01 | 0.3152 |
| | | (2.75) | (1.52) | (2.88) | (1.42) | (2.42) | |
| SMB $GD_t$ | 1966-2002 | 0.03 | 0.00 | -4.72 | 0.15 | 0.00 | 0.0679 |
| | | (1.20) | (0.19) | (1.92) | (0.82) | (1.89) | |
| 1WSMB $GD_t$ | 1966-2002 | -0.02 | 0.01 | -0.10 | 0.20 | 0.01 | 0.0856 |
| | | (1.21) | (1.76) | (0.05) | (1.15) | (2.71) | |

## TABLE 5.7 (CONTINUED)

Panel B: Five-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $D_{t-1}/P_{t-1}$ | $GD5_{t-5}$ | $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GD5_t$ | 1971-1998 | 0.00 | 0.02 | -0.12 | 0.67 | 0.01 | 0.5213 |
| | | (0.02) | (0.33) | (0.27) | (5.09) | (8.24) | |
| Q2 $GD5_t$ | 1971-1998 | 0.03 | 0.01 | -0.34 | 0.35 | 0.01 | 0.6711 |
| | | (0.60) | (0.16) | (1.58) | (1.97) | (5.86) | |
| Q3 $GD5_t$ | 1971-1998 | -0.03 | 0.10 | -0.03 | 0.09 | 0.01 | 0.4814 |
| | | (1.07) | (3.44) | (0.14) | (0.41) | (2.85) | |
| Q4 $GD5_t$ | 1971-1998 | 0.00 | 0.03 | 0.60 | -0.56 | 0.01 | 0.7464 |
| | | (0.03) | (0.85) | (2.62) | (1.71) | (1.56) | |
| Q5 $GD5_t$ | 1971-1998 | 0.00 | 0.09 | 0.51 | -0.34 | 0.01 | 0.6283 |
| | | (0.06) | (2.22) | (1.59) | (1.53) | (2.31) | |
| QPREM GD5 | 1971-1998 | -0.04 | 0.01 | -2.89 | -0.26 | 0.00 | 0.1847 |
| | | (3.14) | (1.25) | (3.00) | (1.37) | (1.83) | |
| SL $GD5_t$ | 1971-1998 | -0.02 | 0.05 | 0.26 | -0.44 | 0.00 | 0.7751 |
| | | (1.29) | (2.08) | (0.48) | (1.56) | (2.26) | |
| BL $GD5_t$ | 1971-1998 | 0.07 | -0.06 | -0.41 | 0.43 | 0.00 | 0.6060 |
| | | (1.11) | (0.68) | (1.21) | (3.44) | (5.00) | |
| SM $GD5_t$ | 1971-1998 | -0.07 | 0.14 | 0.27 | -0.21 | 0.00 | 0.5285 |
| | | (2.35) | (3.57) | (1.05) | (1.10) | (1.30) | |
| BM $GD5_t$ | 1971-1998 | 0.03 | -0.01 | -0.55 | 0.18 | 0.01 | 0.5263 |
| | | (0.79) | (0.10) | (0.75) | (1.57) | (5.11) | |
| SH $GD5_t$ | 1971-1998 | -0.02 | 0.12 | 0.19 | -0.13 | 0.01 | 0.4441 |
| | | (0.64) | (1.46) | (0.68) | (0.41) | (1.35) | |
| BH $GD5_t$ | 1971-1998 | 0.00 | 0.05 | 0.20 | -0.09 | 0.01 | 0.5118 |
| | | (0.06) | (0.92) | (0.61) | (0.38) | (3.52) | |
| SMB $GD5_t$ | 1971-1998 | 0.00 | 0.00 | 2.15 | -0.01 | 0.00 | 0.2929 |
| | | (0.24) | (1.56) | (2.21) | (0.05) | (2.18) | |
| 1WSMB | 1971-1998 | -0.01 | 0.00 | 1.18 | -0.13 | 0.00 | 0.2444 |
| $GD5_t$ | | (0.91) | (1.70) | (1.13) | (0.48) | (2.29) | |

## TABLE 5.7 (CONTINUED)

Panel C: One-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $Y_{t-1}/P_{t-1}$ | $GY_{t-1}$ | $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GY_t$ | 1966-2002 | 0.20 | -0.15 | -1.20 | 0.15 | 0.02 | 0.1533 |
| | | (0.83) | (0.48) | (1.61) | (1.16) | (3.01) | |
| Q2 $GY_t$ | 1966-2002 | 0.35 | -0.44 | -0.78 | 0.42 | 0.02 | 0.3171 |
| | | (1.64) | (1.48) | (0.86) | (2.98) | (3.50) | |
| Q3 $GY_t$ | 1966-2002 | 0.15 | -0.24 | 0.25 | 0.66 | 0.03 | 0.4100 |
| | | (0.82) | (0.86) | (0.24) | (4.24) | (3.21) | |
| Q4 $GY_t$ | 1966-2002 | 0.22 | -0.27 | -0.16 | 0.40 | 0.02 | 0.1928 |
| | | (1.04) | (0.80) | (0.11) | (2.31) | (1.93) | |
| Q5 $GY_t$ | 1966-2002 | 0.09 | -0.03 | -0.26 | 0.47 | 0.04 | 0.2312 |
| | | (0.46) | (0.10) | (0.16) | (3.29) | (1.79) | |
| QPREM $GY_t$ | 1966-2002 | -0.06 | 0.00 | 2.07 | 0.17 | 0.01 | -0.0196 |
| | | (1.93) | (0.15) | (1.21) | (0.90) | (1.79) | |
| SL $GY_t$ | 1966-2002 | 0.27 | -0.39 | 0.51 | 0.32 | 0.02 | 0.2636 |
| | | (1.85) | (1.88) | (0.35) | (1.88) | (3.20) | |
| BL $GY_t$ | 1966-2002 | 0.22 | -0.10 | -2.51 | 0.03 | 0.01 | 0.1451 |
| | | (0.73) | (0.28) | (1.85) | (0.15) | (2.61) | |
| SM $GY_t$ | 1966-2002 | 0.14 | -0.19 | -0.04 | 0.69 | 0.03 | 0.4692 |
| | | (1.13) | (0.86) | (0.04) | (5.43) | (2.61) | |
| BM $GY_t$ | 1966-2002 | 0.36 | -0.28 | -2.26 | 0.18 | 0.01 | 0.2368 |
| | | (1.70) | (0.89) | (3.42) | (1.02) | (2.76) | |
| SH $GY_t$ | 1966-2002 | -0.02 | 0.27 | -0.89 | 0.36 | 0.02 | 0.1520 |
| | | (0.05) | (0.55) | (0.53) | (1.55) | (0.67) | |
| BH $GY_t$ | 1966-2002 | 0.51 | -0.51 | -1.65 | 0.05 | 0.03 | 0.2581 |
| | | (2.18) | (1.68) | (2.03) | (0.22) | (2.64) | |
| SMB $GY_t$ | 1966-2002 | 0.03 | 0.00 | -7.51 | 0.18 | -0.01 | 0.2209 |
| | | (1.24) | (0.12) | (4.05) | (1.09) | (1.34) | |
| 1WSMB $GY_t$ | 1966-2002 | -0.01 | 0.02 | 0.57 | 0.50 | 0.02 | 0.2137 |
| | | (0.32) | (2.40) | (0.45) | (2.67) | (2.87) | |

## TABLE 5.7 (CONTINUED)

Panel D: Five-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $Y_{t-1}/P_{t-1}$ | $GY5_{t-5}$ | $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 GY5t | 1971-1998 | -0.03 | 0.10 | 0.02 | 0.02 | 0.01 | 0.6540 |
| | | (0.26) | (0.56) | (1.21) | (0.23) | (5.07) | |
| Q2 GY5t | 1971-1998 | 0.01 | 0.08 | -0.29 | 0.08 | 0.01 | 0.7653 |
| | | (0.11) | (0.58) | (1.34) | (0.45) | (5.15) | |
| Q3 GY5t | 1971-1998 | -0.05 | 0.21 | -0.23 | -0.06 | 0.01 | 0.6910 |
| | | (0.58) | (1.35) | (1.01) | (0.42) | (2.20) | |
| Q4 GY5t | 1971-1998 | -0.05 | 0.18 | -0.02 | 0.04 | 0.01 | 0.7165 |
| | | (0.77) | (1.68) | (0.09) | (0.15) | (2.88) | |
| Q5 GY5t | 1971-1998 | -0.09 | 0.29 | 0.18 | -0.19 | 0.01 | 0.6842 |
| | | (1.35) | (3.12) | (0.45) | (1.05) | (1.57) | |
| QPREM GY5 | 1971-1998 | -0.10 | 0.00 | 1.13 | -0.58 | 0.00 | 0.3942 |
| | | (8.09) | (0.14) | (1.78) | (3.68) | (1.08) | |
| SL GY5t | 1971-1998 | 0.03 | 0.00 | 0.14 | 0.05 | 0.01 | 0.7732 |
| | | (0.81) | (0.06) | (0.32) | (0.23) | (3.43) | |
| BL GY5t | 1971-1998 | -0.09 | 0.27 | -0.95 | 0.60 | 0.01 | 0.6916 |
| | | (1.36) | (2.95) | (2.93) | (6.18) | (6.56) | |
| SM GY5t | 1971-1998 | -0.15 | 0.32 | -0.09 | 0.01 | 0.01 | 0.7663 |
| | | (1.93) | (2.68) | (0.31) | (0.09) | (2.00) | |
| BM GY5t | 1971-1998 | 0.03 | 0.06 | -0.44 | -0.14 | 0.01 | 0.7175 |
| | | (0.22) | (0.44) | (1.02) | (0.76) | (3.54) | |
| SH GY5t | 1971-1998 | -0.22 | 0.53 | -0.05 | -0.13 | 0.00 | 0.5456 |
| | | (2.61) | (3.03) | (0.21) | (0.75) | (0.55) | |
| BH GY5t | 1971-1998 | 0.02 | 0.02 | 0.18 | -0.03 | 0.01 | 0.3973 |
| | | (0.90) | (0.41) | (1.19) | (0.09) | (1.95) | |
| SMB GY5t | 1971-1998 | 0.03 | 0.00 | -1.05 | -0.52 | 0.00 | 0.3044 |
| | | (2.29) | (1.60) | (1.53) | (1.84) | (0.35) | |
| 1WSMB | 1971-1998 | -0.04 | 0.01 | -0.20 | -0.53 | 0.00 | 0.5408 |
| $GY5_t$ | | (3.55) | (2.67) | (0.37) | (2.11) | (1.14) | |

When considering the five-year average dividend growth in Panel B of Table 5.7, there is also a suspicion that there is multicollinearity in the results. Although regression indicate an adjusted goodness of fit of above 50% in many cases, few of the coefficients are individually significant. The main variable which appears to be the most significant predictor of longer-term dividend growth is the consumption-dividend ratio, being statistically different from zero and intuitively signed in 10 of the 14 regressions. There is also an increase in the incidents of perverse coefficient signs being found especially on the payout ratio and on the dividend-price ratio, which could suggest that perhaps suggests that the model over-fits the data and that a more carefully specified model might be preferable.

Panel C of Table 5.7 presents evidence of predictability of single year earnings growth. Similar to one-year dividend growth with find that $R^2$ is relatively high for most regressions, in general being above 0.2. The exception appears to be for the quintile size premium where the adjusted $R^2$ is negative. We also find some further evidence of individually significant variables. For example, 10 out of 14 consumption-earnings ratios are statistically significant with the correct sign. However, a lot of the variables are insignificantly different from zero. The results for five-year earnings growth shown in Panel D indicates the goodness of fit is extremely high, being above 0.65 in 10 of 14 portfolios. Similar to previous results in this section, few individual coefficients are statistically significant. Although 9 of 14 industries have statistically significant consumption-earnings ratios. Thus, this once more indicates a strong possibility of multicollinearity being present in the regression.

### 5.4.1.3 IN-SAMPLE PREDICTABILITY USING GENERAL-TO-SPECIFIC APPROACH

Given the regressions including all variables appear subject to multicollinearity, we sequentially removed the variable which appears least significant across all the regressions until we arrived at a specification where the majority of variables were significant. As mentioned in the previous section it appears that the ratio of consumption-fundamental is particularly important for predicting future fundamental growth.

In table 5.8 panel A we report that consumption-dividend and prior dividend growth are the only variables important for predicting one-year ahead dividend growth for most portfolios. The consumption-dividend ratio is significant in all but two regressions. Nevertheless the adjusted $R^2$ in general is slightly lower than the original specification including all variables.

However, panel B illustrates that for predicting five-year dividend growth, the consumption-dividend ratio is the only variable that is significant for the majority of portfolios. However, it is significant for all portfolios and moreover it can predict a large portion of future variability in longer-term dividend growth since adjusted $R^2$ is around 0.5 or higher for most portfolios. The adjusted $R^2$'s do appear in general to be slightly smaller than when all potential predictors were included in the regression equation.

## TABLE 5.8: FUNDAMENTAL GROWTH PREDICTABILITY WITH PARSIMONIOUS MODELS

Panel A: One-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $D_{t-1}/P_{t-1}$ | $GD_{t-1}$ | $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GD_t$ | 1966-2002 | 0.00 | | | 0.35 | 0.00 | 0.1201 |
| | | (0.33) | | | (2.59) | (2.18) | |
| Q2 $GD_t$ | 1966-2002 | 0.01 | | | 0.68 | 0.01 | 0.4305 |
| | | (0.74) | | | (4.78) | (5.24) | |
| Q3 $GD_t$ | 1966-2002 | 0.01 | | | 0.62 | 0.02 | 0.3160 |
| | | (0.98) | | | (4.58) | (4.11) | |
| Q4 $GD_t$ | 1966-2002 | 0.01 | | | 0.64 | 0.01 | 0.3680 |
| | | (0.61) | | | (4.60) | (4.32) | |
| Q5 $GD_t$ | 1966-2002 | 0.04 | | | 0.39 | 0.02 | 0.2020 |
| | | (1.55) | | | (2.97) | (3.33) | |
| QPREM $GD_t$ | 1966-2002 | -0.05 | | | 0.06 | 0.00 | 0.0039 |
| | | (1.83) | | | (0.40) | (1.71) | |
| SL $GD_t$ | 1966-2002 | 0.00 | | | 0.11 | 0.00 | 0.0200 |
| | | (0.08) | | | (1.02) | (1.51) | |
| BL $GD_t$ | 1966-2002 | 0.02 | | | -0.11 | 0.00 | 0.1982 |
| | | (0.62) | | | (0.61) | (2.39) | |
| SM $GD_t$ | 1966-2002 | 0.02 | | | 0.42 | 0.01 | 0.1223 |
| | | (1.12) | | | (2.60) | (2.48) | |
| BM $GD_t$ | 1966-2002 | 0.00 | | | 0.35 | 0.01 | 0.1854 |
| | | (0.20) | | | (2.37) | (3.99) | |
| SH $GD_t$ | 1966-2002 | 0.02 | | | 0.52 | 0.02 | 0.2879 |
| | | (1.36) | | | (3.85) | (3.17) | |
| BH $GD_t$ | 1966-2002 | 0.03 | | | 0.27 | 0.02 | 0.2135 |
| | | (1.21) | | | (1.92) | (2.89) | |
| SMB $GD_t$ | 1966-2002 | 0.00 | | | 0.13 | 0.00 | 0.0520 |
| | | (0.13) | | | (0.70) | (2.25) | |
| 1WSMB $GD_t$ | 1966-2002 | -0.02 | | | 0.17 | 0.01 | 0.1164 |
| | | (0.98) | | | (1.00) | (2.79) | |

## TABLE 5.8 (CONTINUED)

Panel B: Five-year Dividend Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $D_{t-1}/P_{t-1}$ | $GD5_{t-5}$ | $CDDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GD5_t$ | 1971-1998 | 0.01 | | | | 0.00 | 0.3376 |
| | | (1.00) | | | | (2.95) | |
| Q2 $GD5_t$ | 1971-1998 | 0.03 | | | | 0.01 | 0.6338 |
| | | (3.51) | | | | (7.44) | |
| Q3 $GD5_t$ | 1971-1998 | 0.03 | | | | 0.01 | 0.4737 |
| | | (3.74) | | | | (8.34) | |
| Q4 $GD5_t$ | 1971-1998 | 0.04 | | | | 0.01 | 0.6364 |
| | | (4.92) | | | | (8.35) | |
| Q5 $GD5_t$ | 1971-1998 | 0.06 | | | | 0.01 | 0.5038 |
| | | (6.73) | | | | (5.96) | |
| QPREM GD5 | 1971-1998 | -0.05 | | | | 0.00 | 0.1926 |
| | | (3.38) | | | | (2.27) | |
| SL $GD5_t$ | 1971-1998 | 0.02 | | | | 0.00 | 0.6565 |
| | | (2.02) | | | | (6.91) | |
| BL $GD5_t$ | 1971-1998 | 0.03 | | | | 0.00 | 0.4964 |
| | | (1.89) | | | | (4.95) | |
| SM $GD5_t$ | 1971-1998 | 0.04 | | | | 0.01 | 0.4651 |
| | | (4.88) | | | | (9.34) | |
| BM $GD5_t$ | 1971-1998 | 0.01 | | | | 0.00 | 0.5519 |
| | | (0.72) | | | | (7.20) | |
| SH $GD5_t$ | 1971-1998 | 0.05 | | | | 0.01 | 0.4697 |
| | | (3.87) | | | | (4.77) | |
| BH $GD5_t$ | 1971-1998 | 0.04 | | | | 0.01 | 0.5410 |
| | | (5.04) | | | | (8.21) | |
| SMB $GD5_t$ | 1971-1998 | 0.01 | | | | 0.00 | 0.3808 |
| | | (0.54) | | | | (2.64) | |
| 1WSMB | 1971-1998 | -0.02 | | | | 0.00 | 0.3090 |
| $GD5_t$ | | (1.92) | | | | (3.99) | |

## TABLE 5.8 (CONTINUED)

Panel C: One-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $Y_{t-1}/P_{t-1}$ | $GY_{t-1}$ | $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 $GY_t$ | 1966-2002 | 0.02 | | | 0.19 | 0.02 | 0.1601 |
| | | (0.89) | | | (1.42) | (3.39) | |
| Q2 $GY_t$ | 1966-2002 | 0.02 | | | 0.51 | 0.02 | 0.3123 |
| | | (1.03) | | | (3.66) | (3.78) | |
| Q3 $GY_t$ | 1966-2002 | 0.02 | | | 0.66 | 0.02 | 0.4363 |
| | | (0.99) | | | (4.67) | (4.93) | |
| Q4 $GY_t$ | 1966-2002 | 0.03 | | | 0.44 | 0.02 | 0.2318 |
| | | (1.02) | | | (3.21) | (3.41) | |
| Q5 $GY_t$ | 1966-2002 | 0.05 | | | 0.49 | 0.04 | 0.2768 |
| | | (1.21) | | | (3.24) | (3.60) | |
| QPREM $GY_t$ | 1966-2002 | -0.06 | | | 0.14 | 0.02 | 0.0040 |
| | | (1.50) | | | (0.76) | (1.90) | |
| SL $GY_t$ | 1966-2002 | 0.03 | | | 0.33 | 0.01 | 0.2627 |
| | | (0.87) | | | (1.97) | (2.64) | |
| BL $GY_t$ | 1966-2002 | 0.02 | | | 0.08 | 0.01 | 0.1115 |
| | | (0.75) | | | (0.38) | (2.40) | |
| SM $GY_t$ | 1966-2002 | 0.02 | | | 0.69 | 0.02 | 0.4943 |
| | | (0.89) | | | (5.97) | (4.57) | |
| BM $GY_t$ | 1966-2002 | 0.02 | | | 0.25 | 0.01 | 0.1474 |
| | | (0.64) | | | (1.44) | (4.32) | |
| SH $GY_t$ | 1966-2002 | 0.04 | | | 0.41 | 0.03 | 0.1810 |
| | | (1.36) | | | (2.23) | (2.88) | |
| BH $GY_t$ | 1966-2002 | 0.04 | | | 0.20 | 0.04 | 0.2172 |
| | | (1.25) | | | (1.16) | (3.69) | |
| SMB $GY_t$ | 1966-2002 | 0.02 | | | 0.18 | -0.01 | 0.0030 |
| | | (0.71) | | | (1.07) | (1.36) | |
| 1WSMB $GY_t$ | 1966-2002 | -0.01 | | | 0.39 | 0.02 | 0.1938 |
| | | (0.78) | | | (2.09) | (2.98) | |

## TABLE 5.8 (CONTINUED)

Panel D: Five-year Earnings Growth Predictability

| Dependent Variable | Sample Period | Constant | $D_{t-1}/Y_{t-1}$ | $Y_{t-1}/P_{t-1}$ | $GY5_{t-5}$ | $CYDT_{t-1}$ | R-bar squared |
|---|---|---|---|---|---|---|---|
| Q1 GY5t | 1971-1998 | 0.03 | | | | 0.01 | 0.6187 |
| | | (3.90) | | | | (10.32) | |
| Q2 GY5t | 1971-1998 | 0.04 | | | | 0.01 | 0.7699 |
| | | (4.61) | | | | (11.16) | |
| Q3 GY5t | 1971-1998 | 0.06 | | | | 0.02 | 0.7143 |
| | | (5.20) | | | | (12.42) | |
| Q4 GY5t | 1971-1998 | 0.06 | | | | 0.02 | 0.7521 |
| | | (5.39) | | | | (8.15) | |
| Q5 GY5t | 1971-1998 | 0.10 | | | | 0.03 | 0.6473 |
| | | (6.99) | | | | (6.68) | |
| QPREM GY5 | 1971-1998 | -0.07 | | | | 0.00 | -0.0292 |
| | | (4.08) | | | | (0.25) | |
| SL GY5t | 1971-1998 | 0.05 | | | | 0.01 | 0.7745 |
| | | (4.94) | | | | (14.07) | |
| BL GY5t | 1971-1998 | 0.03 | | | | 0.00 | 0.3957 |
| | | (1.92) | | | | (4.77) | |
| SM GY5t | 1971-1998 | 0.06 | | | | 0.02 | 0.7667 |
| | | (6.26) | | | | (9.84) | |
| BM GY5t | 1971-1998 | 0.02 | | | | 0.01 | 0.6507 |
| | | (1.96) | | | | (5.95) | |
| SH GY5t | 1971-1998 | 0.08 | | | | 0.02 | 0.5581 |
| | | (4.15) | | | | (6.77) | |
| BH GY5t | 1971-1998 | 0.05 | | | | 0.01 | 0.4961 |
| | | (5.50) | | | | (5.13) | |
| SMB GY5t | 1971-1998 | 0.02 | | | | -0.01 | 0.1093 |
| | | (1.51) | | | | (1.81) | |
| 1WSMB $GY5_t$ | 1971-1998 | -0.03 | | | | 0.01 | 0.3413 |
| | | (2.52) | | | | (6.42) | |

Panel C of Table 5.8 illustrates that consumption-earnings and prior earnings growth are the only variables important for one-year earnings growth predictability. The consumption-dividend ratio is significant in all but two regressions. Nevertheless the adjusted $R^2$ in general is slightly lower than the original specification including all variables but apart from for the size premium portfolios is generally above 0.15.

However, panel D illustrates that for predicting five-year earnings growth, the consumption-earnings ratio is the only variable that is significant for the majority of portfolios. However, it is significant for all portfolios and moreover it can predict a large portion of future variability in longer-term earnings growth since adjusted $R^2$ is around 0.5 or higher for most portfolios. The adjusted $R^2$'s do appear in general to be slightly smaller than when all potential predictors were included in the regression equation. Furthermore, it should also be noted that the size premium portfolios are those which have the smallest proportion of variation that is predictable.

### 5.4.1.4 FORECASTING FUTURE FUNDAMENTAL GROWTH

The empirical evidence for fundamental growth predictability of size portfolios indicates that a large portion of future fundamental growth is predictable. However, the evidence on the preferred model specification is mixed. We find when all four variables are included in the model then relatively few coefficients are significant but the adjusted $R^2$'s are very high and in fact tend to be higher than for more parsimonious versions of the model. These findings are classic symptoms of multicollinearity. Table 5.9 provides average correlations between the predictor variable and illustrates that indeed some of the regressors are highly correlated. For example the de-trended consumption-earnings ratio is highly correlated with the payout ratio and moderately correlated with earnings-price ratio and contemporaneous dividend growth. There are also moderate correlations between the de-trended consumption-dividend ratio and contemporaneous dividend growth as well as between the payout ratio and the earnings-price ratio. Hence it would appear that multicollinearity is present in the results reported in Section 5.4.1.2.

**TABLE 5.9 AVERAGE CORRELATIONS OF REGRESSORS**

Panel A: Average Correlations of 5 Size Quintile portfolios

| | $D_t/P_t$ | $Y_t/P_t$ | $GD_t$ | $GY_t$ | $D_t/Y_t$ | CDDT | CYDT |
|---|---|---|---|---|---|---|---|
| $D_t/P_t$ | 1.00 | 0.88 | -0.11 | 0.13 | 0.08 | -0.12 | -0.14 |
| $Y_t/P_t$ | 0.88 | 1.00 | -0.01 | 0.01 | -0.38 | -0.17 | -0.47 |
| $GD_t$ | -0.11 | -0.01 | 1.00 | -0.05 | -0.22 | -0.41 | -0.44 |
| $GY_t$ | 0.13 | 0.01 | -0.05 | 1.00 | 0.19 | 0.10 | 0.09 |
| $D_t/Y_t$ | 0.08 | -0.38 | -0.22 | 0.19 | 1.00 | 0.10 | 0.70 |
| CDDT | -0.12 | -0.17 | -0.41 | 0.10 | 0.10 | 1.00 | 0.69 |
| CYDT | -0.14 | -0.47 | -0.44 | 0.09 | 0.70 | 0.69 | 1.00 |

Panel B: Average Correlations of 6 Size-Value portfolios

| | $D_t/P_t$ | $Y_t/P_t$ | $GD_t$ | $GY_t$ | $D_t/Y_t$ | CDDT | CYDT |
|---|---|---|---|---|---|---|---|
| $D_t/P_t$ | 1.00 | 0.86 | -0.02 | 0.13 | 0.15 | -0.17 | -0.10 |
| $Y_t/P_t$ | 0.86 | 1.00 | 0.01 | 0.01 | -0.34 | -0.13 | -0.42 |
| $GD_t$ | -0.02 | 0.01 | 1.00 | -0.03 | -0.05 | -0.43 | -0.35 |
| $GY_t$ | 0.13 | 0.01 | -0.03 | 1.00 | 0.18 | 0.08 | 0.09 |
| $D_t/Y_t$ | 0.15 | -0.34 | -0.05 | 0.18 | 1.00 | -0.05 | 0.65 |
| CDDT | -0.17 | -0.13 | -0.43 | 0.08 | -0.05 | 1.00 | 0.62 |
| CYDT | -0.10 | -0.42 | -0.35 | 0.09 | 0.65 | 0.62 | 1.00 |

However, the model where the majority of variables are significant generally has a noticeably poorer (adjusted) goodness of fit than the all-variable model. The issue relating to the parsimonious model is that it possibly suffers from variable omission bias, which could lead to biased coefficient estimates. Whereas, for the full-variable model that seems to suffer from multicollinearity then at least in this situation the coefficient estimates are unbiased. Nevertheless given that both sets of predictive regressions are subject to econometric issues this weakens the evidence provided from forecasts. It is therefore re-assuring that the results from both models are qualitatively very similar. We report the forecasting results from the full-variable model in the text since multicollinearity is a less serious problem than variable omission. We place results from the parsimonious model in appendix 5.1; the results from both models are similar and we discuss the major difference in the following text.

Table 5.10 gives forecasted excess future fundamental growth rates, where they are measured as the forecasted fundamental growth minus the average growth rate. Hence a positive value indicates fundamental growth is expected to be above average in the future and thus is deemed to be an "optimistic" forecast. Conversely, we deem forecasts of fundamental growth below the historical average to be "pessimistic".

Panel A of Table 5.10 indicates an optimistic forecast of one-year dividend growth for 2003 across all portfolios apart from the Big-High portfolio. Furthermore the average for 2001-2003 indicates that this trend has been apparent over recent years in almost all portfolios. The magnitude predicted for dividend growth is also large commonly being forecasted to be 5% or more higher than average. Nevertheless we should be somewhat cautious as to how we interpret these results as the accuracy of the forecasts might be somewhat suspect due to the recent changes in corporate dividend policy.

## TABLE 5.10: FORECASTS OF FUNDAMENTAL GROWTH

Panel A: 1-year Dividend Growth Forecasts including all variables

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 10.71% | 6.26% | Optimistic | Optimistic |
| Q2 | 18.50% | 3.62% | Optimistic | Optimistic |
| Q3 | 16.26% | 5.33% | Optimistic | Optimistic |
| Q4 | 9.13% | -2.28% | Optimistic | Pessimistic |
| Q5 | 7.94% | 2.23% | Optimistic | Optimistic |
| Q EQPREM | 7.20% | 7.88% | Optimistic | Optimistic |
| SL | 26.75% | 15.91% | Optimistic | Optimistic |
| BL | 6.46% | 10.48% | Optimistic | Optimistic |
| SM | 16.85% | 7.14% | Optimistic | Optimistic |
| BM | 12.61% | 4.03% | Optimistic | Optimistic |
| SH | 4.33% | 3.32% | Optimistic | Optimistic |
| BH | -2.68% | -2.71% | Pessimistic | Pessimistic |
| SMB | 1.85% | 2.05% | Optimistic | Optimistic |
| 1WSMB | 9.56% | 8.79% | Optimistic | Optimistic |

Panel B: 1-year Earnings Growth Forecasts including all variables

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 16.71% | 12.78% | Optimistic | Optimistic |
| Q2 | 13.26% | 4.72% | Optimistic | Optimistic |
| Q3 | 17.90% | 2.53% | Optimistic | Optimistic |
| Q4 | 9.62% | -0.31% | Optimistic | Pessimistic |
| Q5 | 1.72% | 0.02% | Optimistic | Optimistic |
| Q EQPREM | 9.53% | 8.42% | Optimistic | Optimistic |
| SL | 24.67% | 12.24% | Optimistic | Optimistic |
| BL | 19.63% | 25.72% | Optimistic | Optimistic |
| SM | 11.00% | 2.57% | Optimistic | Optimistic |
| BM | 10.27% | 3.64% | Optimistic | Optimistic |
| SH | 1.88% | 0.76% | Optimistic | Optimistic |
| BH | -2.38% | -3.40% | Pessimistic | Pessimistic |
| SMB | 10.38% | 12.09% | Optimistic | Optimistic |
| 1WSMB | 17.79% | 13.21% | Optimistic | Optimistic |

## TABLE 5.10 (CONTINUED)

Panel C: 5-year Dividend Growth Forecasts including all variables

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 7.71% | 6.66% | Optimistic | Optimistic |
| Q2 | 11.62% | 7.69% | Optimistic | Optimistic |
| Q3 | 8.77% | 5.60% | Optimistic | Optimistic |
| Q4 | 10.42% | 2.35% | Optimistic | Optimistic |
| Q5 | 5.89% | 2.24% | Optimistic | Optimistic |
| Q EQPREM | 4.91% | 7.63% | Optimistic | Optimistic |
| SL | 23.87% | 14.07% | Optimistic | Optimistic |
| BL | 4.42% | 5.96% | Optimistic | Optimistic |
| SM | 3.61% | 1.59% | Optimistic | Optimistic |
| BM | 11.34% | 3.45% | Optimistic | Optimistic |
| SH | 3.56% | 2.36% | Optimistic | Optimistic |
| BH | -2.23% | -3.46% | Pessimistic | Pessimistic |
| SMB | 2.10% | 1.13% | Optimistic | Optimistic |
| 1WSMB | 3.76% | 5.14% | Optimistic | Optimistic |

Panel D: 5-year Earnings Growth Forecasts including all variables

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 9.26% | 6.55% | Optimistic | Optimistic |
| Q2 | -1.29% | -0.61% | Pessimistic | Pessimistic |
| Q3 | 2.97% | 2.37% | Optimistic | Optimistic |
| Q4 | 0.66% | -0.97% | Optimistic | Pessimistic |
| Q5 | -3.60% | -3.41% | Pessimistic | Pessimistic |
| Q EQPREM | -2.13% | -3.27% | Pessimistic | Pessimistic |
| SL | 1.31% | 0.62% | Optimistic | Optimistic |
| BL | 19.98% | 17.71% | Optimistic | Optimistic |
| SM | -7.42% | -4.64% | Pessimistic | Pessimistic |
| BM | 5.27% | 1.66% | Optimistic | Optimistic |
| SH | -1.34% | 0.07% | Pessimistic | Optimistic |
| BH | -1.70% | -3.03% | Pessimistic | Pessimistic |
| SMB | -0.37% | -1.90% | Pessimistic | Pessimistic |
| 1WSMB | 7.07% | 4.63% | Optimistic | Optimistic |

Table 5.10 Panel B also supports the suggestion that future one-year fundamental growth could be higher in the near future than the past. An optimistic forecast of one-year earnings growth for 2003 is found across all portfolios apart from for the Big-High portfolio, mirroring the one-year dividend growth results. Furthermore the average for 2001-2003 indicates that this trend has been apparent over recent years in almost all portfolios. Earnings growth is forecasted to be substantially above average for 2003 in almost all portfolios. Although the average forecast for one-year earnings growth for 2001-2003 is in almost all cases smaller than for just 2003, but is nevertheless still "optimistic" for almost all portfolios. Therefore it appears there are grounds to suspect that short-term fundamental growth is expected to be above average in the short-term.

However, the longer term outlook is of greater interest in relation to our equity premium results. Panel C of Table 5.10 indicates that five-year dividend growth is also forecast to be substantially above average both for 2003-2008 and also for averages beginning in 2001, 2002 and 2003. The only exception is for the BH portfolio, which thus far has provided results contrary to the consensus in all our forecasts thus far. Another common pattern is also apparent, namely, that the 2003-2008 forecast is of greater magnitude than the average of the forecasts beginning in 2001, 2002 and 2003.

Table 5.10 Panel D, however indicates that the longer term outlook for earnings growth is rather mixed across the different size and size-value portfolios. In fact the results found don't exhibit many strong patterns across portfolios. Nevertheless, the largest firms from the one-way sort (Q1) are forecast to have substantially higher than average earnings growth over the next five years, whereas the smallest firms from the one-way sort (Q5) are forecast to have substantially lower than average earnings growth. For the two-way sorted there is little clear pattern in the results. The big-low portfolio is forecast to have exceptionally high earnings growth over the next five years, whereas the big-high portfolio is forecast to have below average earnings growth. The other two-way forecasts are somewhat mixed except for the small-medium portfolio which is forecast to have extremely low earnings growth. Overall, the forecasts are rather mixed. However, this set of forecasts for longer term earnings growth are the only ones where there is a substantial discrepancy with those from the more parsimonious model depicted in appendix 5.1. The more parsimonious model results are much more consistent with the previous findings and suggest that longer-term earnings growth can be expected to be substantially above average in most portfolios.

Panel D of Table 5.10 also supports the suggestion that future five-year fundamental growth could be higher in the near future than the past. An optimistic forecast of one-year earnings growth for 2003 is found across all portfolios apart from like one-year dividend growth for the Big-High portfolio. Furthermore the average for 2001-2003 indicates that this trend has been apparent over recent years in almost all portfolios. Earnings growth is forecasted to be substantially above average for 2003 in almost all portfolios. Although the average forecast for one-year earnings growth for 2001-2003 is in almost all cases smaller than for just 2003, but is nevertheless still "optimistic" for almost all portfolios. Therefore it appears there are grounds to suspect that short-term fundamental growth is expected to be above average in the short-term.

#### 5.4.1.5 CONCLUSION

Our empirical analysis finds that dividend growth and earnings growth are predictable in-sample, especially for longer horizons and for the individual size portfolios. The degree of predictability is markedly lower for the size premium portfolios. Nevertheless, we find evidence suggestive of multicollinearity when we include all relevant variables, since the goodness-of-fit is high but relatively few regressors are significant. When insignificant variables are removed we find that the role of the consumption-fundamental ratio as a key determinant of future fundamental growth at both horizons is further underlined. This adds to recent US-centric literature that identifies consumption as playing a key role in predicting future stock prices and fundamental growth rates. We also find that at the one-year horizon lagged fundamental growth is an important adjunct to the consumption-fundamental ratio for predictability.

Whilst, this evidence of fundamental growth predictability is interesting and important, in relation to the equity premium the forecasts of future fundamental growth rates are most pertinent. Our dividend growth equity premia results can be reconciled with the higher historical average equity premia results if high future dividend growth is expected. In fact, we do find evidence supportive of higher than average dividend growth for most portfolios with the exception of the big-high portfolio. This suggests that at least part of the discrepancy in the dividend equity premia results appears due to future dividend growth being forecast to be high.

For earnings growth our results are more mixed especially at the longer horizon. At the one-year horizon earnings growth is found to generally forecast to be above average. However, at the five-year horizon the all-variable model results are very mixed, although the forecasts from the more parsimonious model are consistent with an above-average forecast of fundamental growth. Our equity premia results from the earnings growth model were broadly in-line with the historical average once the 1974 crash was adjusted for, and thus we would not necessarily expect future earnings growth to be particularly different from average.

### 5.4.2 DO EXPECTED STOCK RETURNS FALL DURING THE 1966-2002 PERIOD?

If expected returns have declined on average over time then a stream of unexpected capital gains may have been triggered causing realised historical returns to be substantially above investors' expectations. In these circumstances estimations of the equity premium implied by fundamentals, which are essentially unaffected by changes in expected returns, will give us estimates of the true *ex ante* risk premium that are not contaminated by unanticipated share price appreciation.

There have been a number structural changes to the economies of the World's leading nations over the last century, which could have caused the cost of equity capital to fall. For example, over recent decades markets around the world have become increasingly open and integrated (Stulz, (1999)), there are now much greater opportunities for portfolio diversification (Merton, (1987)), the conditional variance of global real cashflow growth has declined (Bansal and Lundblad, (2002)) and finally, transaction costs have declined effectively lowering the rate of return demanded by investors (Aiyagari and Gertler, (1993) and Jones (2000)).

If factors such as these have occurred, then it is quite plausible that the cost of equity capital has fallen or our future growth expectations have risen. If either or both have occurred during the latter part of the 20th Century, then this would stimulate rises in the equity price index unforeseen by rational investors. Thus, the true *ex-ante* equity premia might be considerably below the 6-8% estimates based upon historical investment returns. If this is the case then the magnitude of the equity premium puzzle will have been overstated by studies which have employed historical returns. Thus, the equity premium puzzle is likely to be smaller than previously thought.

The prior literature, based almost exclusively on studies of the US suggests that there has been a fall in expected returns over recent decades. Studies which attempt to identify the underlying economic causes of such a change in expected return identify the 1990s as the time when this shift occurred (Lettau et al. (2006), Bansal and Lundblad (2002)). This literature can be connected to a related literature which has studied structural breaks in valuation ratios via the present value framework. If there is a shift in the dividend-price (or earnings-price) ratio then this suggests that there has been a change in expected returns. This is given the perceived wisdom that the dividend-price ratio fails to predict long-term future dividend growth. Previous studies have found a downward break in ratios of fundamentals-price for the aggregate US (Carlson et al. (2002)) and UK (Vivian (2005)) markets during the 1990s.

We provide new evidence on whether there has been a change in expected returns by examining if there has been any structural breaks in the fundamental-price ratios of size and size-value portfolios. If the market results of Carlson et al. (2002) for the US and our results from empirical chapter 3 are really in response to a pervasive economic risk factor, we should find breaks in the same direction at a similar time to be evident across diversified portfolios of stocks however formed. This, of course, includes portfolios formed on the basis of size and size-value. Consequently our analysis here could shed new light upon whether the market fall in fundamental-price ratios were due to a change in risk or if not due to a change in risk then highlight the characteristics of the firms causing this result.

We use the procedures developed by Bai and Perron ((1998), (2003)) to investigate the possibility of multiple regimes in UK earnings-price ratios. For a full description of these procedures see Chapter 4.2.4. In order to determine the number of breaks in the series Bai and Perron (1998) advocate the use of the $SupF_T(1)$ test followed by sequential $SupF_T(l+1|l)$ tests to determine the appropriate 0number of breaks. However, they also acknowledge that Bayesian information criteria or modified Bayesian information criteria could be useful for determining the number of breaks. We report modified Bayesian information (LWZ) criterion of Liu et al. (1997), to help verify our results. However, we do note that as found by Perron (1997) that the LWZ criterion could over-estimate the number of breaks in the presence of autocorrelation, which regressions with our application to earnings-price ratios are highly prone to.

### 5.4.2.1 SIZE PORTFOLIOS

Table 5.11 reports results from $SupF_T$, $SupF_T(l+1|l)$ tests and LWZ criterion over the period 1965-2002. For the dividend-price ratio we find, as in the previous chapter 4, that the $SupF_T(1)$ indicates there is no structural break for some portfolios, specifically the second largest firm quintile (Q2) and the middle quintile (Q3). However, for both Q2 and Q3 dividend-price ratios the $SupF_T(2)$ and $SupF_T(3)$ tests indicate that there are structural breaks in the series, The $SupF_T(2)$ indicates 2 rather than 0 and the $SupF_T(3)$ suggests 3 rather than 0 breaks. The failure of the $SupF_T(1)$ test to reject the null of 0 breaks in favour of the alternative of 1 could be due to the series we examine appearing to go through a period of high earnings-price ratio during the 1970s and then reverting back towards its previous mean in the 1980s or 1990s. The alternative hypothesis would have to allow for two breaks in the series in order to capture such a phenomena. Therefore we modify the procedure advocated by Bai and Perron (1998) to select the appropriate number of breaks in the series if and only if the $SupF_T(1)$ indicates there are no breaks we use the $SupF_T(2)$ test to identify if there were at least two breaks in the series and then use the $SupF_T(3|2)$ test to examine if there were three rather than two breaks.

For all the size quintiles the modified sequential procedure indicates two breaks in the dividend-price ratio apart from for the largest firms (Q1). The LWZ modified information criterion also indicates two breaks for all quintile dividend-price ratio apart from for the largest firms (Q1) for which a single break is supported. There also appears to be multiple breaks in the quintile size premium dividend-price ratio, where according to all three criterion there is a single break.

For the quintile earnings-price ratios two breaks are found by the modified sequential procedure for all portfolios. The LWZ modified information criterion also indicates there is 2 breaks for all the portfolios apart from for the largest firms where it finds 3 breaks. There are also multiple breaks found in the quintile size premium earnings-price ratio by both the modified sequential and LWZ criterion. However, there is disagreement over the number of breaks. The modified sequential approach suggests 3 breaks, but the LWZ criterion only 2. It is unusual for the LWZ criterion to suggest a smaller number of breaks than the modified sequential approach since the simulation results of Perron (1997) indicate the LWZ criterion tends to be upwardly biased in series which are highly persistent, such as earnings-price ratios.

## TABLE 5.11: BAI-PERRON TESTS OF MULTIPLE STRUCTURAL BREAKS

Panel A: Size Portfolio Dividend-Price Ratios

| | SupFT(1) | SupFT(2) | SupFT(3) | SupF(2\|1) | SupF(3\|2) | No. of Breaks Selected Sequential | Modified Sequential | LWZ | BIC |
|---|---|---|---|---|---|---|---|---|---|
| Size Quintile Portfolios | | | | | | | | | |
| Q1 | 5.18 | 7.30 | 7.23 | 0.98 | 4.34 | 1 | 1 | 1 | 3 |
| Q2 | 4.23 | 14.82 | 29.44 | 7.50 | 1.13 | 0 | 2 | 2 | 2 |
| Q3 | 3.77 | 13.55 | 12.34 | 7.11 | 1.51 | 0 | 2 | 2 | 2 |
| Q4 | 6.01 | 13.00 | 9.79 | 10.87 | 0.43 | 2 | 2 | 2 | 2 |
| Q5 | 18.56 | 17.01 | 26.68 | 9.34 | 1.46 | 2 | 2 | 2 | 2 |
| Q5-Q1 | 16.49 | 8.70 | 7.72 | 1.92 | 1.11 | 1 | 1 | 1 | 1 |
| Size-Value Portfolios | | | | | | | | | |
| SL | 11.35 | 9.15 | 7.70 | 4.59 | 4.59 | 1 | 1 | 1 | 2 |
| BL | 12.75 | 11.81 | 16.11 | 2.26 | 1.31 | 1 | 1 | 1 | 1 |
| SM | 6.01 | 9.38 | 15.70 | 8.16 | 1.57 | 2 | 2 | 2 | 3 |
| BM | 3.27 | 9.25 | 10.29 | 7.00 | 3.00 | 0 | 2 | 2 | 2 |
| SH | 2.13 | 10.20 | 6.33 | 9.72 | 0.50 | 0 | 2 | 0 | 2 |
| BH | 1.22 | 0.66 | 9.64 | 1.18 | 0.01 | 0 | 0 | 0 | 0 |
| SMB | 7.77 | 5.29 | 2.50 | 1.04 | 0.51 | 1 | 1 | 1 | 1 |
| 1S-B | 2.87 | 4.16 | 2.90 | 4.81 | 1.01 | 0 | 0 | 0 | 1 |

Panel B: Size Portfolio Earnings-Price Ratios

| | SupFT(1) | SupFT(2) | SupFT(3) | SupF(2\|1) | SupF(3\|2) | No. of Breaks Selected Sequential | Modified Sequential | LWZ | BIC |
|---|---|---|---|---|---|---|---|---|---|
| Size Quintile Portfolios | | | | | | | | | |
| Q1 | 4.47 | 9.98 | 14.42 | 15.35 | 5.10 | 2 | 2 | 3 | 3 |
| Q2 | 4.56 | 10.39 | 6.89 | 13.34 | 0.18 | 2 | 2 | 2 | 2 |
| Q3 | 6.59 | 15.96 | 10.96 | 16.49 | 0.08 | 2 | 2 | 2 | 2 |
| Q4 | 1.54 | 14.38 | 16.30 | 26.38 | 6.01 | 0 | 2 | 2 | 2 |
| Q5 | 6.53 | 20.49 | 15.82 | 22.88 | 1.74 | 2 | 2 | 2 | 2 |
| Q5-Q1 | 4.19 | 15.22 | 32.60 | 14.42 | 8.34 | 0 | 3 | 2 | 3 |
| Size-Value Portfolios | | | | | | | | | |
| SL | 7.72 | 12.03 | 9.20 | 6.62 | 1.86 | 1 | 2 | 2 | 2 |
| BL | 3.59 | 13.73 | 12.04 | 16.89 | 5.82 | 0 | 2 | 2 | 2 |
| SM | 1.15 | 13.11 | 11.28 | 24.58 | 2.67 | 0 | 2 | 2 | 2 |
| BM | 3.26 | 9.01 | 8.09 | 4.17 | 6.25 | 0 | 1 | 2 | 2 |
| SH | 7.86 | 25.71 | 17.35 | 21.60 | 2.15 | 2 | 2 | 2 | 2 |
| BH | 12.84 | 14.98 | 11.99 | 15.05 | 7.56 | 3 | 3 | 2 | 2 |
| SMB | 3.16 | 19.23 | 15.09 | 22.29 | 2.07 | 0 | 2 | 2 | 2 |
| 1S-B | 5.68 | 7.30 | 28.98 | 9.51 | 5.70 | 2 | 2 | 2 | 3 |

# TABLE 5.12 STRUCTURAL BREAK TIMINGS AND MAGNITUDES

Panel A: Size Portfolio Dividend-Price Ratios

| 1965-2( | No. of | BREAK 1 | | | BREAK 2 | | | OVERALL | |
|---|---|---|---|---|---|---|---|---|---|
| | Break | DATE | + or - | SIZE | DATE | + or - | SIZE | + or - | CHANGE |
| Size Quintile Portfolios | | | | | | | | | |
| Q1 | 1 | 1992 | Down | -1.18% | | | | Down | -1.18% |
| Q2 | 2 | 1974 | Up | 1.61% | 1982 | Down | -2.06% | Down | -0.45% |
| Q3 | 2 | 1974 | Up | 1.76% | 1981 | Down | -2.05% | Down | -0.29% |
| Q4 | 2 | 1974 | Up | 1.61% | 1981 | Down | -2.34% | Down | -0.73% |
| Q5 | 2 | 1974 | Up | 1.53% | 1981 | Down | -3.00% | Down | -1.47% |
| Q5-Q1 | 1 | 1980 | Down | -1.39% | | | | Down | -1.39% |
| Size-Value Portfolios | | | | | | | | | |
| SL | 1 | 1982 | Down | -2.19% | | | | Down | -2.19% |
| BL | 1 | 1982 | Down | -1.20% | | | | Down | -1.20% |
| SM | 2 | 1974 | Up | 1.77% | 1983 | Down | -2.46% | Down | -0.69% |
| BM | 2 | 1974 | Up | 1.35% | 1981 | Down | -1.88% | Down | -0.53% |
| SH | 0 | | | | | | | No Change | |
| BH | 0 | | | | | | | No Change | |
| SMB | 1 | 1984 | Down | -0.73% | | | | Down | -0.73% |
| 1S-B | 0 | | | | | | | | |

Panel B: Size Portfolio Earnings-Price Ratios

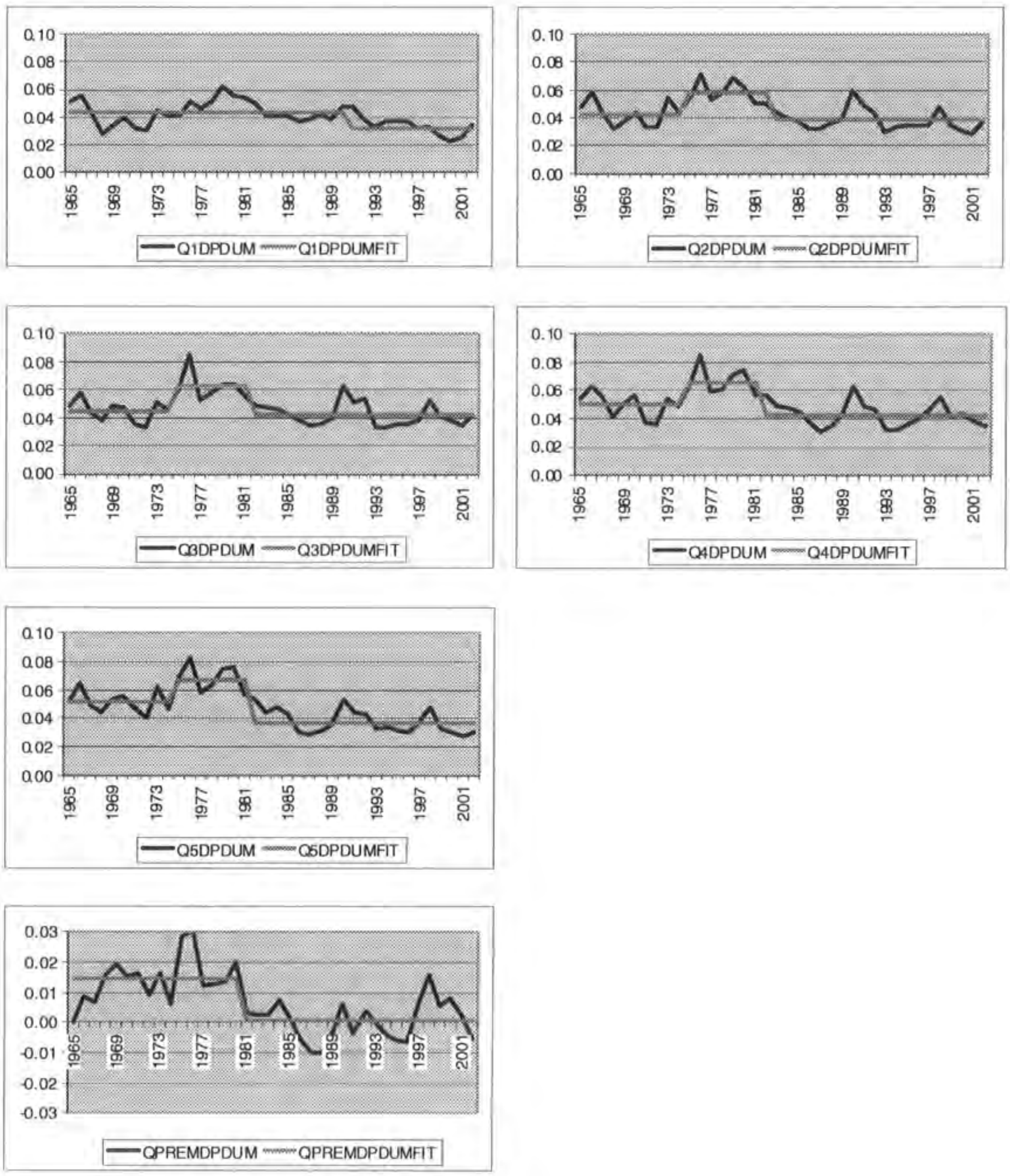
| 1965-2( | No. of | BREAK 1 | | | BREAK 2 | | | OVERALL | |
|---|---|---|---|---|---|---|---|---|---|
| | Break | DATE | + or - | SIZE | DATE | + or - | SIZE | + or - | CHANGE |
| Size Quintile Portfolios | | | | | | | | | |
| Q1 | 2 | 1972 | Up | 3.30% | 1990 | Down | -3.05% | Up | 0.24% |
| Q2 | 2 | 1972 | Up | 4.92% | 1979 | Down | -3.77% | Up | 1.15% |
| Q3 | 2 | 1972 | Up | 4.90% | 1979 | Down | -3.61% | Up | 1.29% |
| Q4 | 2 | 1972 | Up | 4.54% | 1980 | Down | -3.94% | Up | 0.60% |
| Q5 | 2 | 1972 | Up | 3.88% | 1980 | Down | -4.81% | Down | -0.94% |
| Q5-Q1 | 2 | 1979 | Down | -2.87% | 1995 | Up | 2.75% | Down | -0.12% |
| Size-Value Portfolios | | | | | | | | | |
| SL | 2 | 1972 | Up | 2.32% | 1979 | Down | -3.25% | Down | -0.92% |
| BL | 2 | 1972 | Up | 3.21% | 1979 | Down | -3.33% | Down | -0.12% |
| SM | 2 | 1972 | Up | 4.49% | 1980 | Down | -3.83% | Up | 0.66% |
| BM | 2 | 1972 | Up | 4.87% | 1980 | Down | -4.09% | Up | 0.78% |
| SH | 2 | 1972 | Up | 6.13% | 1980 | Down | -4.41% | Up | 1.72% |
| BH | 2 | 1972 | Up | 6.68% | 1981 | Down | -4.12% | Up | 2.56% |
| SMB | 2 | 1976 | Down | -1.51% | 1987 | Up | 1.36% | Down | -0.15% |
| 1S-B | 2 | 1978 | Down | -1.74% | 1995 | Up | 2.64% | Up | 0.90% |

For the two-way sorted size-value portfolios dividend-price ratios we report that the number of breaks to some extent appears to depend upon the value characteristic of the portfolio. For dividend-price both low-value portfolios small-low (SL) and big-low (BL), a single break is found by all three methods. For both medium-value portfolios, SM and BM, two breaks are found by both the modified sequential method and the LWZ criterion. Whereas for the high-value portfolios, no breaks are found by any measure of the three measures for the large firms (BH). Although for the small-high portfolio (SH) the LWZ criterion suggests that there is a single break, similar to the BH portfolio, as does the standard sequential procedure. However, the $\text{SupF}_T(2)$ test indicates there are 2 rather than 0 breaks and thus suggests there are multiple breaks in the ratio. In terms of the size premium there is a single break in the SMB size premium according to all 3 methods, in line with the quintile size premium finding. Although for the one-way sorted median size breakpoint portfolio (1WSMB) we find no breaks whatsoever in the premium.

For the earnings-price ratio, there is evidence in favour of multiple breaks in the two-way sorted portfolios, as we found for the size quintile portfolios. The LWZ modified Bayesian information criterion indicates two breaks for all six size-value portfolios. The finding of two breaks is also supported by the modified sequential approach for the three small portfolios. In contrast, out of the large firms only the big-low (BL) portfolio is deemed to have two breaks by the modified sequential method. By the modified sequential approach, the BM portfolio is found to have just a single break and the BH portfolio is found to have three breaks. In terms of the measures of the size premium, both SMB and 1WSMB portfolios are found to have two breaks in their earnings price ratio by both the modified sequential and the LWZ criterion. Thus, multiple breaks in the size premium earnings-price ratio are endorsed.

Our empirical analysis reported in Table 5.11, generally finds structural breaks in the means of the valuation ratios examined and in many cases provides evidence of multiple breaks in these series. We now progress to examine the timing and direction of these structural breaks.

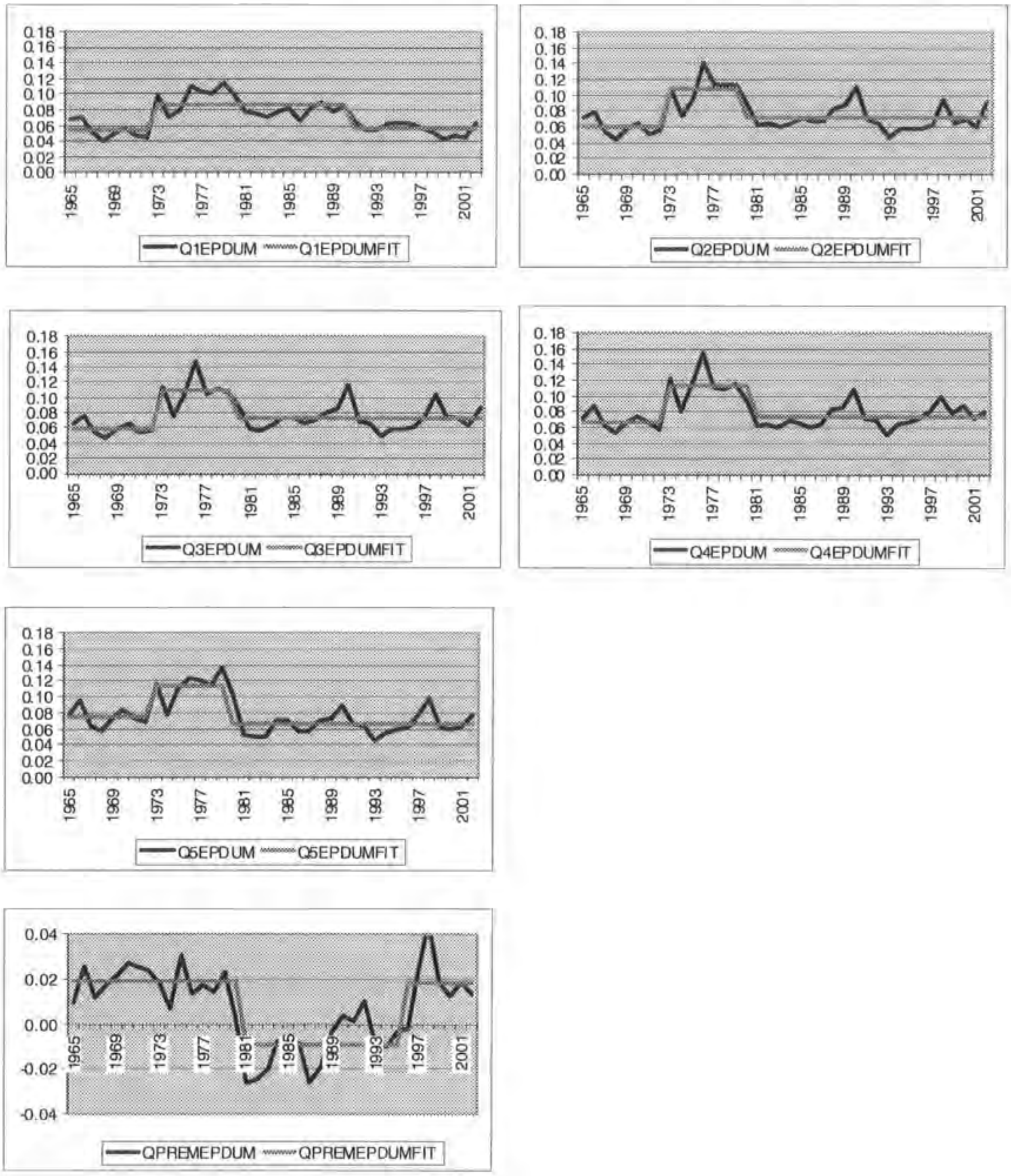
**FIGURE 5.1: ONE-WAY SORTED DIVIDEND-PRICE RATIOS**



In Table 5.12, we find that size portfolio dividend-price ratio breaks tend to occur at approximately the same time. For the quintile dividend-price ratios we find two breaks in all the ratios apart from the largest (Q1). For Q2-Q5 the timings of these breaks occur at almost precisely the same time. There is an upward mean-break in 1974 in the four smallest quintiles of approximately 1.6%, suggesting that firms of these sizes were approximately equally hit by the OPEC oil crisis. The four smallest quintiles also report an almost common downward break in the dividend-price ratio in 1981-2, which seems to be greater in magnitude for all groups than the first break. The second break also appears asymmetric in magnitude, particularly the sharpest fall is for the smallest quintile (Q5) of 3% and the second smallest group (Q4) also experiences a sharper fall (2.34%) than the larger groups (Q2 and Q3) which both have falls of little more than 2%, 2.05% and 2.06% respectively. The very largest firms (Q1) appear to have an idiosyncratic break in 1992, at the same time as we found for the market overall in our first empirical chapter. However, this doesn't seem to translate well to the other size deciles.

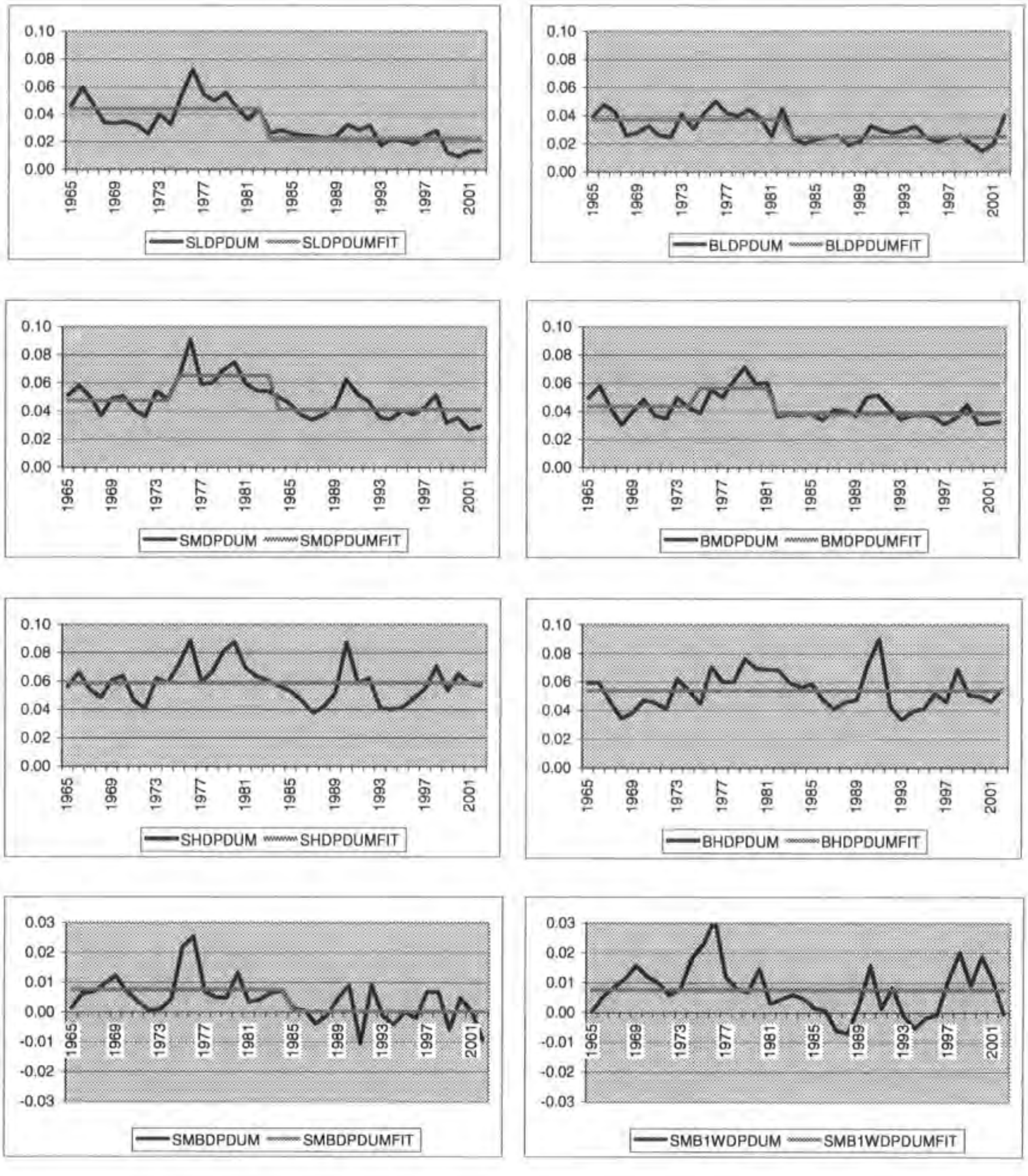
Overall, it appears that firms smaller than the middle quintile experienced larger declines in their dividend-price ratios. Particularly the smallest quintile (Q5) has the largest decline in dividend-price ratio of all. However, the largest firms have a statistically significant break at a different, later time than the other size quintiles and this decline in terms of magnitude is greater than the middle quintile. Whilst this is the case, however, the quintile size premium (Q5-Q1) dividend-price ratio only has a single significant break in 1980, of -1.39%. This suggests the differential between the smallest and largest firms dividend-price ratios declined substantially in 1980 and that the other breaks in the individual series didn't have a statistically significant impact upon the differential between dividend-price ratios.

## FIGURE 5.2: ONE-WAY SORTED EARNINGS-PRICE RATIOS



The size earnings-price ratios breaks also usually appear to have a common timing, although the break timings differ slightly between dividend-price and earnings-price. The quintile earnings-price ratios reveal two breaks for all size groups, even the largest firms. Again the timings of these breaks are virtually identical across groups and similar to those found in their dividend-price ratios. A common upward break is found across all quintiles in 1972, slightly prior to the first break found in most dividend price ratios in 1974. Unlike the 1974 break in dividend-price ratio, this break appears to hit the quintiles asymmetrically, the impact is lowest for the largest firms (3.30%), high for the middle quintile (4.90%), but also less severe for the smallest quintile (3.88%). The second break is uniformly downwards and for the four smallest quintiles it occurs in 1979-1980, again slightly prior to the dividend-price break. For the largest firms the second break which is downward occurs in 1990. The impact of this second break appears strongest for the smallest firms (4.81%), has approximately the same impact upon the middle three size quintiles (3.61-3.94%), whilst the later break for the largest firms is of smaller magnitude (3%). The quintile size premium also has two breaks, in 1979 and 1995. This first break coincides with the downward break of the smallest quintile in 1980, and the second a little after the downward break of the largest firms in 1990. These breaks in the quintile size premium (Q5-Q1) earnings-price ratio almost entirely offset each other, the 1979 break being -2.87% and the 1995 break being 2.75%. Consequently, this suggests little change in the mean earnings-price ratio between the beginning and end of the sample period overall. Thus this implication of the earnings-price ratio of little change is contrary to that implied by the dividend-price ratio, which did suggest a significant fall.

## FIGURE 5.3: TWO-WAY SORTED DIVIDEND-PRICE RATIOS




For the two-way sorted portfolios the number of breaks in dividend-price appears to depend on the value characteristics of the portfolio. For both size categories, no breaks are found for the high-value portfolios, one break for the low-value portfolio and two breaks for the middle-value portfolios. The timings of these breaks, where they are found, is consistent with the one-way sorted results. An upward break is found for the middle-value portfolios of both sizes with the timing between 1974 being the same as for most of the one-way sorted portfolios. A downward break is found for both low-value and both middle-value portfolios during 1981-83, again at a very similar timing to most one-way sorted portfolios.

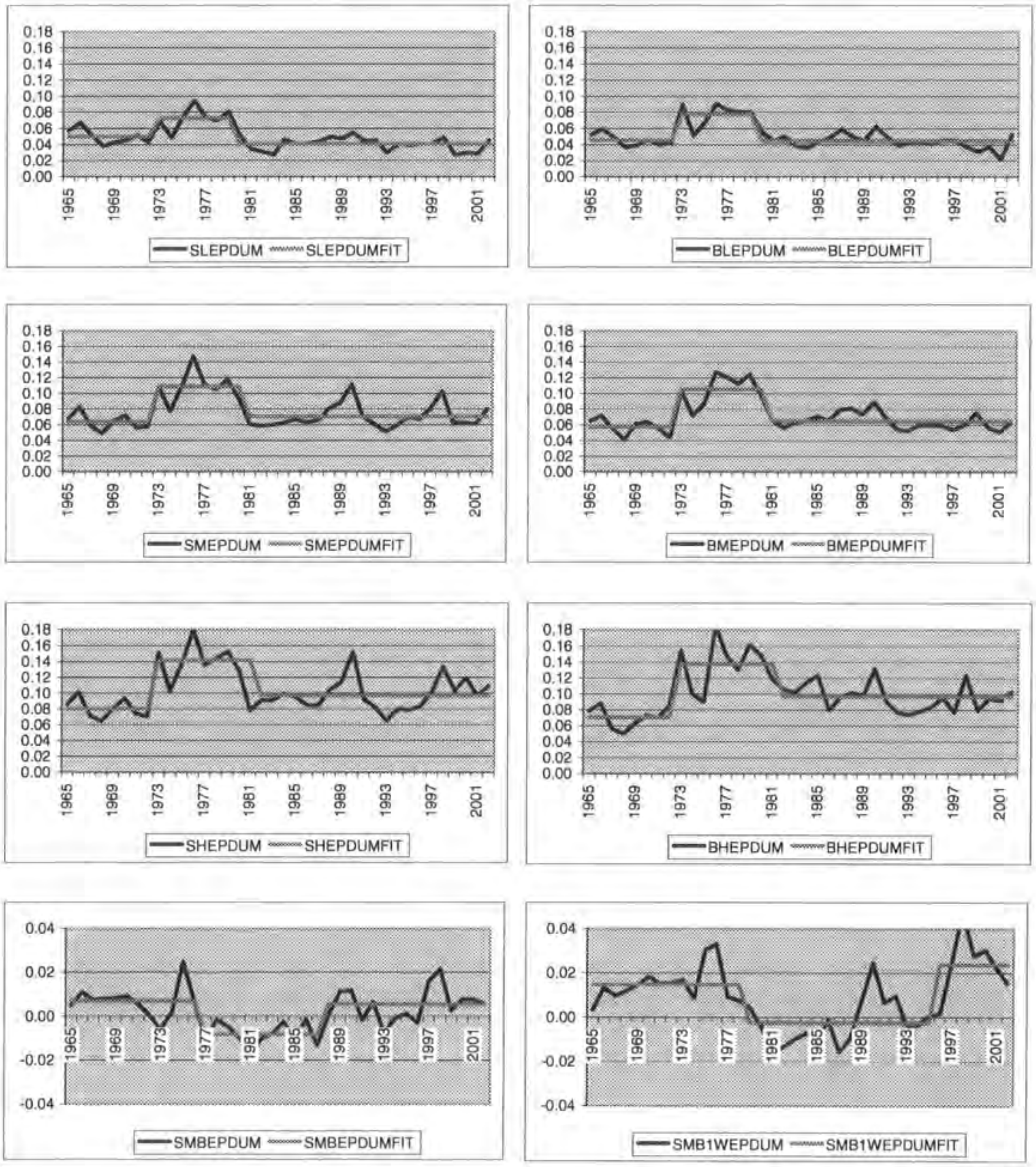
However, the net impact[53] of these breaks is asymmetric across portfolios and seems to be related both to size and value. Specifically the change in dividend-price mean is negatively related to value; the strongest fall is found for the low-value (growth) portfolios and, of course, no fall is found for high-value (glamour) portfolios since there aren't any structural breaks. For portfolios where structural breaks were found the impact is stronger for the small portfolios than the large, hence the impact appears also to be inversely related to size. This is also borne out in the change in the SMB dividend-price ratio which fell 0.73%, although given the timing of the fall in 1974, it suggests this change is driven by the middle-value portfolios since these were the only ones to experience a break around this time. Therefore, it is perhaps, not that unsurprising that no break at all was found in the one-way sorted median breakpoint size premium's (1WSMB) dividend-price ratio given the SMB break occurred when only the middle value-portfolios experienced a break.

For the two-way sorted portfolios earnings-price ratios the number of breaks appears to be two for almost all portfolios. A downward break is found for all 6 portfolios during 1972 and all portfolios also have an upward break between 1979-1981. The net impact of these breaks similarly to the dividend-price results, appear to be related both to size and value. Specifically the change in earnings-price mean is negatively related to value; falls are only found for the low-value (growth) portfolios and, the largest rises are found for high-value (glamour) portfolios. For portfolios where structural breaks were found the impact is also inversely related to size; the SL

[53] that is the change in mean from the beginning of the sample period to the end

portfolio has a lower change (a larger fall) than the BL portfolio, while the rise in the earnings-price ratio is smaller for the SH portfolio than the BH portfolio.

**FIGURE 5.4: TWO-WAY SORTED EARNINGS-PRICE RATIOS**




Two breaks are also found in the SMB earnings-price ratio, however, these are found to occur in 1976 and 1987 at times when none of the individual series have breaks. Although, actually the net impact of these changes are marginal (-0.15%) and so overall there seems to be little clear change overall in this indicator. The 1WSMB earnings-price ratio also appears to have two breaks one an upward one in 1978, and a downward one in 1995. These differences in timings are somewhat difficult to reconcile. The net impact is larger for the 1WSMB portfolio, but is not really that substantially different from that of SMB. Therefore, overall, there doesn't appear to have much of a decline in the size premium from sample start to sample end. However, it does appear that the lower mean during the 1980s is consistent with a lower expected size premium during that period.

#### 5.4.2.2 SUMMARY

Firstly, an upward break is found in the valuation ratios of most size and size-value portfolios during the early1970s around the time of the first OPEC oil crisis in 1974 and the ensuing period of high inflation and economic instability and uncertainty in the UK economy. This effect is found to be substantial across all individual size and size-value earnings price ratios. It is also evident in the dividend-price ratios of the one-way size sorted portfolios apart from the very largest firms (Q1). However, for the dividend-price ratio there is less evidence of a break in the 1970s amongst the size-value two-way sorted portfolios since only the middle-value portfolios (SM and BM) have an upward break at this time. Overall, though, these findings are of interest particularly since prior studies only find evidence of mean-breaks indicating a fall in expected returns whereas we provide some evidence of an upward mean break implying a rise in expected returns.

Secondly, in almost all size and size-value portfolios there is a downward break in valuation ratios during the early 1980s. For portfolios, which experienced an upward break in the early 1970s this break tends to be of an approximately equal magnitude, thus largely counteracting the previous break. In terms of the dividend-price ratio, all size portfolios except for the largest firms (Q1) have a downward break in the early 1980s and there is also a downward break in the quintile size premium. The size-value dividend-price ratios tend to have a downward break between 1981-84 as well apart from the high-value portfolios. The SMB size premium though does have a downward break in dividend-price in 1984. For the earnings-price ratios there is a downward break in all size and size-value portfolios (except the largest size quintile) between 1979-1981. Consequently these results provide evidence suggestive that these breaks were in response to a common economic factor since almost all portfolios were affected at approximately the same time. It is purported that this break could simply have occurred due to the resolution the economic instability and uncertainty faced by the UK economy in the mid-to-late 1970s.

Thirdly, however, we find very limited evidence of a break in valuation ratios during the 1990s. Only in the largest single size sorted portfolio (Q1) do we find a break in the 1990s, although for this portfolio both the dividend-price and earnings-price ratio have downward breaks. Therefore, in stark contrast, to studies of the aggregate market. For instance, Carlson, Pelz and Wohar (2002) report a downward structural break in the mean of fundamental-price ratios during the early 1990s in the US while Vivian (2005) finds a downward break in the UK dividend-price ratio at a similar time. The general interpretation of a shift in a valuation ratio is that it is indicative of a change in expected return, particularly since fundamental growth is difficult to predict. However, our size portfolio results question whether this could have been the case for the break in the early 1990s in the UK since we find little evidence of a common downward break in valuation ratios in the 1990s. Rather the break appears to be concentrated purely in the largest firms by market capitalisation. Since the remaining size portfolio valuation ratios were relatively unaffected, it suggests that this result was not caused by a pervasive economic risk factor causing a change in expected returns. This is because if a change in expected returns had been caused by a pervasive economic risk factor then one would expect the valuation ratios of all industries to be affected. However, our results indicate that only the very largest firms experience a statistically significant shift in their earnings-price ratio during the 1990s. Perhaps, it is more likely this episode can be ascribed to a change in expectations of future fundamental growth affecting the largest corporations.

The overall net changes to the valuation ratios from the structural breaks are somewhat mixed. For the dividend-price ratios, if there are any breaks then the net effect of these are downwards. The biggest net downward shifts for the one-way sorted size portfolios are for the largest and smallest quintiles. The results for the size-value portfolios indicate that the impact is substantial (greater than 1%) only for the low value (earnings-price) portfolios rather than the impact being consistent across all value groupings. Consequently it seems as if glamour firms (low earnings-price) are tending on average to pay lower dividends, if they pay any at all given the rising instances of zero-dividend firms.

The overall net changes for the earnings-price ratios tend to be positive in general, although there are few instances where there is a large change. Hence, our earnings-price results, in general, are not supportive that expected returns fell overall during the period 1966-2002. However, there is not much evidence either of a substantive overall net rise in earnings-price ratios either. Only in the second (Q2) and third (Q3) largest size quintiles is there an upward net movement in earnings-price of more than 1%. For the two-way sorted size-value portfolios there is a substantial upward movement for both the high-value (value) portfolios, but only a slight upward movement in the middle-value portfolios and slight downward movement in the low-value portfolio. Furthermore, there are disparities between the earnings-price results and the dividend-price results in terms of the net impact of the structural breaks discovered.

Overall, the net impact of the change in valuation ratio seems to depend on whether one is looking at dividend-price or earnings price. For earnings-price the net changes are generally positive but of rather small magnitude. In contrast for dividend-price we find the net changes are generally negative and sometimes of large magnitude. Hence, the results are rather mixed. Nevertheless, the timing of the breaks where they are found have a strong degree if commonality. In almost all cases structural breaks occur are prior to the 1990s, contrary to existing literature. The exception to this is for the very largest firms where a downward break is found in the early 1990s at a similar time as the aggregate market.

Nevertheless, the structural break results appear generally consistent with the equity premia results. There is generally little overall change in the earnings-price ratio which supports the finding that the earnings model provides very similar equity premia estimates to the historical average model. Whereas, there tends to be a general net decline in the dividend-price ratio over 1966-2002 which is consistent with the equity premia findings that dividend growth estimates are less than the historical average. Therefore the overall picture is somewhat mixed, but there is limited support for an overall fall in expected returns over 1966-2002; support which is further qualified by the drawbacks of dividend method inherent due to the changing nature of payout policy during this period.

## 5.5 CONCLUSION

The empirical analysis suggests that the degree to which historical equity premia have been supported by fundamentals is dependent upon the measure of fundamentals used. If dividends are used to calculate expected returns then it appears that actual returns have been above expectations across size portfolios as we found for examining the aggregate market equity premium in chapter 3. The dividend growth model also suggests the historical size premium was also above investors' expectations. However, if earnings are used as an alternative proxy of underlying performance, then the historical estimates are largely consistent with those implied by earnings growth and in fact few large deviations exist between these estimates. Nevertheless there are drawbacks to using either dividends or earnings to measure fundamental performance; hence both sets of results require consideration. Thus, our results are mixed on the main issue addressed in this thesis: whether or not the historical equity premium accurately estimates the expected equity premium.

These differences between the results of the dividend and earnings growth model are similar to those reported in Chapter 4 for industry portfolios. In Chapter 4 we also found a disparity between dividend growth and historical equity premia estimates but no substantive difference between earnings growth and historical equity premia estimates. Whilst it is plausible that a primary cause of this is the recent trends in corporate payout policy that affect the dividend estimates it is also possible that earnings management, for instance, could have inflated earnings estimates. Hence, this appears an area which could benefit from further research, perhaps including share repurchases into dividends would circumvent the major failings of the dividend method and provide a more accurate estimate of the expected equity premium.

In terms of the size premium we find that a positive size premium could be expected for the full sample. Small firms do have higher earnings and dividend growth than large firms and this result for the full sample period is robust when the value grouping of stocks is held constant. We also find that only a small proportion of the raw size premium is due to systematic differences in exposure to the value premium as is demonstrated by size-value sorted SMB equity premium estimates being only slightly smaller than the one way sorted 1WSMB equity premium.

Our results also indicate that both the historical size premium and expected size premium is positive overall in both the pre-discovery (1966-1984) and post-discovery (1985-2002) sub-periods. However, we also report findings consistent with Dimson and Marsh (1999) that the *historical* UK size premium did go into reverse over 1989-1998. Our results for the *expected* size premium 1989-1998 indicate that this was negative only once value is controlled; the results are mixed for the one-way size sorted premium but they provide paltry support for a strong positive expected size premium during 1989-1998. Thus, we find the nature of both the expected and historical size premium appear to deviate from the norm of a strong positive premium for 1989-1998.

Our overall results shed important new light on the nature of the size premium. They reject the assertion that the size premium is simply a statistical artefact borne from the data-mining exploits of over-exuberant researchers. Instead our results suggest that small firms not only on average received higher returns than large firms but furthermore they indicate that small firms can be expected to earn higher returns than large firms during both pre-discovery and post-discovery sub-periods. This is because small firms have superior underlying fundamental performance than large firms and thus earn higher capital gains. In this sense a size premium can be expected.

We examine if there are structural breaks in the ratios of fundamental to price which could help explain our equity premia results and why we find the patterns in dividend growth and earnings growth portfolios we do.

The structural break results for the dividend-price ratio are consistent with the equity premia results we report. There is a decline in the dividend-price ratio in almost all portfolios and in most cases this is of substantial magnitude. Moreover for the size premium we also find a decline in the dividend-price ratio for our main measures the quintile premium and SMB premium. The timing of these declines are fairly consistent across portfolio, generally occurring in the early-1980s, with the exception being the largest firm portfolio which has a decline in 1992[54]. Thus, these results are consistent with the discrepancy between dividend growth equity premia and historical average premia. In general, such declines in the dividend-price ratio are interpreted as a decline expected returns (e.g. Fama and French (2002)), that has caused prices to rise unexpectedly. However, there are other possible explanations for this result especially given that the size premium has thus far evaded an adequate explanation in terms of an economic risk factor.

In terms of the dividend yield on the size premium our descriptive statistics also indicated that, small firms had higher yields than large firms during the pre-discovery period (1966-1984). However, since 1985 this differential has disappeared and both small and large firms offer very similar yields. These results are consistent across both the size and size-value sorted results. It is tempting to interpret these results as following the discovery of the size premium small firms are priced such that they no longer have to offer such higher yields than large firms to entice shareholders

[54] The large firm portfolio break is found to occur at precisely the same time as the dividend-price break we find for the market overall.

to hold them. Thus, it is possible that the result comes from a re-evaluation of smaller company prices in light of the size premium discovery.

However, there is good reason to suspect that it is not a change in prices but a change in dividends that has played an important role in explaining the decline in dividend-price ratio. Recent changes in corporate dividend policy appear not to have been symmetrical impact across firms of different sizes. DeAngelo, DeAngelo and Skinner (2004) demonstrate there is an increasing concentration of dividend payouts amongst the very largest US firms. Ap Gwilym et al. (2002) provide evidence that such a trend is also apparent in the UK and also note that small firms are more likely to be non-payers of cash dividends than large firms. Consequently, it appears plausible that changing dividend policy has made a large contribution to the disappearance of the difference in yield between small and large firms during the sample period[55].

The hypothesis that the disappearance of the dividend yield differential between small and large firms is caused primarily by dividend behaviour rather than prices is further supported if one examines the earnings yield. We find that overall, a differential between earnings yield remains at the end of the sample period. Since prices are common components to both earnings and dividend yields this suggests the change in dividend yield on the size premium is not mainly due to a move in prices.

For the earnings-price ratio structural break tests on the size premium portfolios, also indicate that the differential in the final regime is approximately the same as the initial regime. This is also consistent with our equity premia results for the size premium that earnings growth and historical average estimates were broadly similar. However, we find there tend to be multiple regimes in the earnings-price

[55] Or alternatively why the differential which disappeared in the 1980s didn't re-appear in the 1990s

ratios. The difference in earnings-price ratios between small and large firms turns negative around 1980 and then turns positive again during the 1990s. These appear to more or less to coincide with the structural breaks on the individual portfolios. Small portfolios have a downward break around 1980 but large firms have a later downward break in the early 1990s. However, overall for the one-way sorted size portfolios there is relatively little change in the earnings-price ratio between first and final regimes consistent with the equity premia results. Although for the two-way sorted portfolios these show an increasing spread of earnings-price ratios in the cross-section of firms. High earnings-price portfolios have higher final than first regime values while for the low earnings-price ratio portfolios have the lowest net changes. These results appear consistent with Pastor and Veronesi (2003) who find US firm earnings tend to have experienced an increase in volatility over recent years.

We find further evidence of fundamental growth predictability, in this instance for size and size-value portfolios. We find the consumption-fundamental ratio is the most important variable for predicting future fundamental growth at both short and medium term horizons. Additionally, at the short one-year horizon, we find lagged fundamental growth rates act as an important adjunct to the consumption-fundamental ratio for predictability. However, predicting fundamental growth for the size premium portfolios, our regression results indicate is a more difficult task.

In terms of forecasting future fundamental growth rates, dividend growth forecasts suggest that in general above average growth can be expected. This is supportive of the hypothesis that the discrepancy between our dividend growth and historical average equity premia estimates is partly due to the anticipation of higher future dividend growth. However, for earnings growth the results are more mixed especially when the longer term outlook is considered. Although above average earnings growth is forecast at the one-year horizon, at longer horizons the support for above average fundamental growth is much weaker. Nevertheless, since the equity premia results were similar for the earnings growth model and the historical average model once the 1974 crash was adjusted for, and thus we would not necessarily expect future earnings growth to be particularly different from average.

Therefore forecasts of future fundamental growth are generally consistent with our equity premia results. However, it isn't clear whether they are able to offer close to a full explanation of the equity premia results. This is because although strong future dividend growth is forecast this could be in part due to the recent rise in UK share repurchase activity (Oswald and Young (2004)), which appears to have reduced the total cash dividends paid. This would affect the predicted mean reversion of the consumption-dividend, dividend-price and payout ratios since they would forecast total dividends to meant revert which also comprises share repurchases. Hence forecasts that future cash dividends will rise should be interpreted cautiously.

Overall the empirical results are mixed on the focal issue of this thesis the expected equity premium. Expected equity premium results from earnings growth model coupled with generally little net change in the mean of earnings-price ratio suggests expected returns in 2002 are about the same as in 1966. However equity premium results from dividend growth model together with findings, generally, of falls in the mean of the dividend-price ratio imply a fall in expected returns during the sample period. There is also some, albeit weak evidence, suggesting an increase in expectations of future dividend growth could contribute to the dividend model equity premium findings. Nevertheless, on our main issue of interest the results are mixed with some evidence pointing to a fall in expected equity premium across size portfolios, whilst other results suggest there has been little change.

## APPENDIX 5.1: FORECASTING RESULTS FROM PARSIMONIOUS MODEL

Panel A: 1-year Dividend Growth Forecasts excluding Dividend-Price and Payout

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 9.18% | 3.86% | Optimistic | Optimistic |
| Q2 | 15.50% | 1.09% | Optimistic | Optimistic |
| Q3 | 13.25% | 1.94% | Optimistic | Optimistic |
| Q4 | 3.51% | -5.10% | Optimistic | Pessimistic |
| Q5 | 6.71% | 1.65% | Optimistic | Optimistic |
| Q EQPREM | 6.77% | 6.01% | Optimistic | Optimistic |
| SL | 22.41% | 12.34% | Optimistic | Optimistic |
| BL | 13.73% | 16.68% | Optimistic | Optimistic |
| SM | 15.73% | 5.92% | Optimistic | Optimistic |
| BM | 6.88% | -3.64% | Optimistic | Pessimistic |
| SH | 0.74% | 2.99% | Optimistic | Optimistic |
| BH | -5.61% | -7.79% | Pessimistic | Pessimistic |
| SMB | 4.81% | 1.00% | Optimistic | Optimistic |
| 1WSMB | 8.88% | 8.22% | Optimistic | Optimistic |

Panel B: 1-year Earnings Growth Forecasts excluding Earnings-Price and Payout

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 16.45% | 10.06% | Optimistic | Optimistic |
| Q2 | 6.93% | -2.90% | Optimistic | Pessimistic |
| Q3 | 11.94% | -1.60% | Optimistic | Pessimistic |
| Q4 | 2.92% | -4.70% | Optimistic | Pessimistic |
| Q5 | 0.91% | -0.92% | Optimistic | Pessimistic |
| Q EQPREM | 14.16% | 9.29% | Optimistic | Optimistic |
| SL | 9.18% | -0.41% | Optimistic | Pessimistic |
| BL | 24.44% | 16.70% | Optimistic | Optimistic |
| SM | 5.05% | -1.65% | Optimistic | Pessimistic |
| BM | 5.81% | -2.97% | Optimistic | Pessimistic |
| SH | 6.58% | 3.67% | Optimistic | Optimistic |
| BH | -5.76% | -6.63% | Pessimistic | Pessimistic |
| SMB | 4.59% | 1.36% | Optimistic | Optimistic |
| 1WSMB | 17.35% | 13.06% | Optimistic | Optimistic |

APPENDIX 5.1 (CONTINUED)

Panel C: 5-year Dividend Growth Forecasts CDDT

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 7.70% | 6.86% | Optimistic | Optimistic |
| Q2 | 10.49% | 6.60% | Optimistic | Optimistic |
| Q3 | 10.43% | 6.67% | Optimistic | Optimistic |
| Q4 | 12.39% | 4.26% | Optimistic | Optimistic |
| Q5 | 8.20% | 5.31% | Optimistic | Optimistic |
| Q EQPREM | 4.62% | 4.59% | Optimistic | Optimistic |
| SL | 29.16% | 17.84% | Optimistic | Optimistic |
| BL | 9.67% | 9.53% | Optimistic | Optimistic |
| SM | 15.06% | 8.53% | Optimistic | Optimistic |
| BM | 10.65% | 2.70% | Optimistic | Optimistic |
| SH | 4.68% | 3.09% | Optimistic | Optimistic |
| BH | -1.81% | -2.75% | Pessimistic | Pessimistic |
| SMB | 3.94% | 2.10% | Optimistic | Optimistic |
| 1WSMB | 3.01% | 4.95% | Optimistic | Optimistic |

Panel D: 5-year Earnings Growth Forecasts CYDT

| | 2002 Prediction | Av. 2000-2002 Prediction | 2002 | Av. 2000-2002 |
|---|---|---|---|---|
| Q1 | 10.28% | 7.61% | Optimistic | Optimistic |
| Q2 | 0.89% | 0.47% | Optimistic | Optimistic |
| Q3 | 8.09% | 6.09% | Optimistic | Optimistic |
| Q4 | 5.48% | 1.85% | Optimistic | Optimistic |
| Q5 | 4.11% | 3.25% | Optimistic | Optimistic |
| Q EQPREM | 1.27% | 0.90% | Optimistic | Optimistic |
| SL | 2.66% | 1.97% | Optimistic | Optimistic |
| BL | 18.04% | 14.79% | Optimistic | Optimistic |
| SM | 3.62% | 3.13% | Optimistic | Optimistic |
| BM | 6.20% | 1.18% | Optimistic | Optimistic |
| SH | 5.21% | 4.80% | Optimistic | Optimistic |
| BH | -1.30% | -2.51% | Pessimistic | Pessimistic |
| SMB | 1.96% | -0.20% | Optimistic | Pessimistic |
| 1WSMB | 8.79% | 7.51% | Optimistic | Optimistic |

# CHAPTER 6: SUMMARY OF FINDINGS AND CONCLUDING REMARKS

This thesis examines the equity premium in the context of the historical experience of the UK market. Therefore this thesis meets one of our initial objectives outlined in the introduction to fill part of the void in the current equity premium literature which thus far has been heavily centred on America. More specifically we set the objective to ascertain whether or not the historical equity risk premia of the magnitude observed is a suitable and fitting proxy for the expected UK equity risk premia that could have been anticipated. We examine this issue through recourse to the historical underlying performance of equities. To this end we posed several questions to stimulate the subsequent research enclosed in this thesis.

In Chapter 2, we presented a review of the literature with a particular focus on the equity premium puzzle. We identified that although numerous modifications have been proposed to the theoretical model that these all seem to fall short of providing a solution that doesn't require a seemingly implausible level of risk aversion. In this thesis we therefore follow a different approach. We find from the literature that especially in the UK context little prior work has consider whether the observed historical equity premia is an appropriate proxy for expected returns which are prescribed by theoretical models. We therefore focus on this issue for the subsequent empirical analysis of the UK equity premium in Chapters 3, 4 and 5.

- To what extent have historical equity premia been supported by the underlying performance of fundamentals?

- Are there any discrepancies between historical returns and those implied by fundamentals?
- Do alternative measures of fundamentals yield results that are consistent with each other?
- Do the specific characteristics of the UK market lead to results that differ from other markets?
- Are the results for the aggregate market generalisable to portfolios formed according to cross-sectional characteristics?

In general, we find that historical equity premia have been largely supported by fundamental growth in each of the empirical studies conducted in this thesis. A strong relationship is apparent between long run average stock returns and long run fundamental growth. However, while this is the case and the following remarks should be seen in this context, we do also find a number of cases where the fundamental estimates of equity premia do diverge to an economically substantial degree from those given by the historical average.

In Chapter 3, we looked at the UK equity premium from a long-term perspective using data covering the whole of the 20$^{th}$ Century. Our empirical analysis demonstrates that during the earlier part of the 20$^{th}$ Century both dividend growth and capital gains methods provide similar estimates of the equity premia. We find that in the latter part of the 20$^{th}$ Century equity premia appeared to be above those implied by dividend growth. In Chapter 4 and 5 respectively we scrutinised the equity premium across industry portfolios and size portfolios respectively. We discovered over the period 1966-2002 that historical average equity premia were also above those implied by dividend growth for almost all industry or size portfolios. Therefore there appears to be a strong degree of consistency in the analysis from our empirical studies indicating that the magnitude of the historical equity premium over recent decades was above investors' expectations based on dividend growth models.

The UK has an important different key characteristic to that of the US market where the overwhelming majority of prior empirical studies in this area have been conducted. This is that changes in dividend payout policy, which could affect dividend growth model estimates, have been more apparent in the US. In the US dividends have declined dramatically since the 1970s, whilst at the same time share repurchases activity has proliferated. This has affected the estimates of dividend growth models of expected equity returns based purely on "cash" dividends. In the UK cash dividends have also become less important but this has been a very recent phenomenon, partly due to share repurchases being illegal in the UK until the 1980s. Consequently, UK dividend growth estimates should be substantially less affected or subject to these changes than US studies also based upon cash dividends.

Nevertheless, we also examine earnings growth as an alternative measure of fundamentals for the period for which it is also available from 1966-2002. In spite of the UK market being less susceptible to any impact on dividend growth model estimates from changes to payout policy than the US, earnings growth is essentially devoid of this bias altogether. Our empirical analysis of portfolios sorted by cross-sectional characteristics demonstrates that if earnings growth is used to measure expected returns then the results relating to the equity premia differ and differ to a substantive degree to those for which dividend growth is used.

In Chapter 4 we find that across the majority of UK industries once the 1974 market crash is removed then historical equity premia were approximately the same as those implied by earnings growth. Nevertheless, even after the 1974 outlier is controlled for there was a divergence between the dividend growth equity premia estimate and the historical average estimate. We also find that for the value-weighted aggregate market a small discrepancy pervaded between earnings growth and historical average equity premia and a larger discrepancy between dividend growth and the historical average consistent with the aggregate findings from chapter 3. In Chapter 5, we considered the equity premia across size portfolios. Here we also found that historical average equity premia were approximately the same as that implied by earnings growth. However, the dividend growth estimate, once more, diverged from the other estimates. The key implication of these results using earnings growth as a measure of expected return is that these are very close in the main to the historical average return for cross-sectional portfolios, whether they are formed on the basis of industry or on market capitalisation.

- Are deviations of historical returns from those implied by fundamentals due to a change in expectations of future fundamental growth?
- Is there time variation in expectations of future fundamental growth?

We will begin by examining the latter question. Until recently it has been maintained that future growth of earnings and dividends was essentially unpredictable. In this thesis we provide new evidence on the predictability of fundamental growth. We find that fundamental growth is predictable in the time series both in our aggregate analysis in chapter 3 and in the cross-sectional analysis of industry portfolios and size portfolios in chapters 4 and 5 respectively.

Our results suggest there is an important role for ratios of fundamentals in the predictability of future fundamental growth. For instance, ratios of aggregate consumption-earnings and aggregate consumption-dividends perform extremely well in explaining time-series variation in fundamental growth of industry and size portfolios respectively. In Chapter 3, at the aggregate level we find an important role for a similar ratio the dividend-price ratio in predicting future fundamental growth. Although, the dividend-price ratio performed strongly at the aggregate level overall and especially in the earlier part of the 20$^{th}$ Century, its predictive ability has lessened over recent years, which we suspect is partly due to the recent changes in UK dividend payout policy. We also find that prior fundamental growth rates also have an important role to play in predicting future fundamental growth. For size and industry portfolios, particularly at shorter horizons, they enhance predictability conducted with the consumption-fundamental ratio alone. At the aggregate, lagged fundamental growth is important and appears to have become increasingly important for predicting aggregate fundamental growth during the second part of the 20$^{th}$ Century.

Despite uncovering evidence indicating that fundamental growth is predictable, we find limited evidence that changes in expectations of future fundamental growth can explain the deviations of historical equity premia from those implied by fundamental growth. For instance, across UK industries we find that in a number of industries historical equity premia had diverged from those implied by fundamentals over 1966-2002 once appropriate adjustments for outliers had been made. However, although in some industries changes in expectations of future fundamental growth appear capable of explaining these discrepancies in some of the industries, it was unable to do so for others. Furthermore, in some industries where no discrepancies were found a changes in expected future fundamental growth was discovered. Such a pattern of results suggests that changing expectations of future fundamental growth are not the driving force behind our industry equity premia results. At the aggregate level in Chapter 3 we discovered that historical equity premia had been on average above those implied by fundamentals since 1951. However, our results suggest that the historical average is the best forecaster out-of-sample, which predicts only a slight increase in the dividend growth rate for 2002 onwards relative to that predicted in 1951. Consequently, the empirical evidence from this thesis suggests that the ability of a change in expectations of future fundamental growth appears to have very limited in its ability to explain the equity premium results discovered.

We find little support for the hypothesis that aggregate expected dividend growth is expected to be high post 2002.

- Are deviations of historical returns from those implied by fundamentals due to a change in expectations of future returns?
- Have there been any structural changes in the relationship between prices and fundamentals?

Firstly, we provide evidence that there are structural changes between prices and fundamentals in the UK. Such structural change is evident across all three empirical chapters of this thesis. In Chapter 3 we discover a structural break in the market dividend-price ratio in the early 1990s. This would appear to suggest that there has been a change in expected return caused by a decline in the discount rate. Such evidence for the aggregate market is consistent with there being a decline in expected returns, which could have caused prices to rise unexpectedly. However, what is less clear is what factor precisely was behind this shift in market dividend-price and whether or not this shift is mirrored across different segments of the market.

Importantly, in chapter 4 we do not find common breaks in valuation ratios during the 1990s questioning whether the shift in market dividend-price was in fact caused by a change in risk in the 1990s. It appears more likely that this was due to a change in the industry composition of the market during the 1990s. An increase in the weight being placed on new, growing industries with low ratios of fundamental-price such as pharmaceuticals, telecoms and media could have caused this result. We also find for size portfolios, in chapter 5, that only the largest firms experience a downward break in their valuation ratios during the 1990s whereas smaller portfolios only experience breaks prior to the 1990s. Again this would suggest that the shift in the 1990s wasn't in fact due to a change in systematic risk but rather to some other factor. An intuitive explanation would be that advanced in Chapter 4 that this was due to an increasing proportion of large firms being from low fundamental-price industries such as pharmacuticals, telecoms and media.

Although, for cross-sectional portfolios we generally fail to find structural breaks in valuation ratios during the 1990s, we do discover that there were earlier shifts in these ratios. In fact these breaks occurred at remarkably similar timings across portfolios. For both size and industry portfolios we find a general, pervasive and substantial upward shift in valuation ratios during the early 1970s around the time of the first OPEC oil crisis of 1974. We also find for both size and industry portfolios there is a common decline in valuation ratios in the early 1980s. For the earnings-price ratios these two shifts largely offset each other leading to the initial regime exhibiting very similar mean earnings-price to the final regime. However, in the case of dividend-price ratios, the tendency was for the shift in the 1980s to be of larger magnitude resulting in an overall decline in dividend-price ratios. Nevertheless these empirical results for size portfolios and industry portfolios suggest that risk induced shifts in expected returns did occur during our sample period. However, the timing of these breaks are prior to the break in the aggregate dividend price ratio from Chapter 3 that occurred during the early 1990s.

The conclusions of this thesis regarding whether or not historical equity premia have diverged from those implied by fundamentals requires further discussion. Our Chapter 3 study of the aggregate market appears not to be in full agreement with the results of the studies from cross-sectionally formed portfolios within the market in Chapter 4 and Chapter 5. There are also notable differences in the results from structural break tests, especially in relation to the timing of aggregate market breaks and those of individual portfolios.

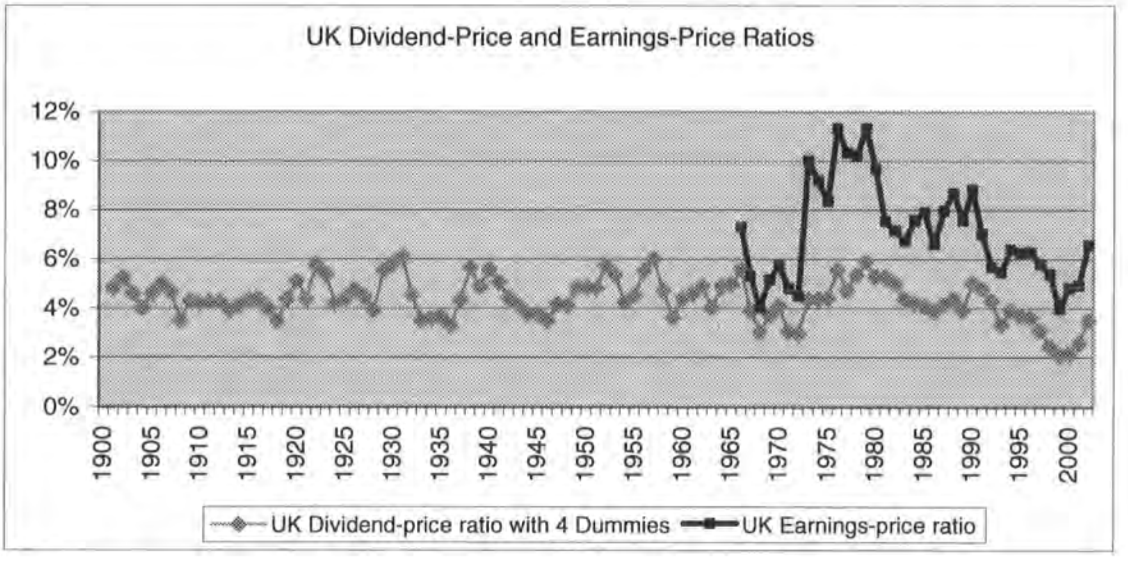
Therefore we should review our interpretation of the results in Chapter 3 given the further new light shed on the issue from our cross-sectional analyses in Chapters 4 and 5. In particular, in Chapter 3 we discover the structural break in the aggregate dividend-price ratio occurs in the early 1990s and such breaks are generally ascribed to a permanent decline in expected returns. However, our subsequent analysis of cross-sectional portfolios in Chapters 4 and 5 indicates that there is little evidence for a downward break in ratios of fundamental-price during the 1990s across industry or across size groupings. Consequently the evidence that such a break did not occur during the 1990s in most of the individual cross-sectional portfolios questions the assertion that there truly was a decline in the conventional equity premium during the 1990s due to decline in risk.

We find in several industries a structural break is found in the early 1990s, and also the largest firm quintile experiences a structural break in the early 1990s. Hence it appears that these segments of the market appear to be driving the appearance of a break in the aggregate fundamental-price ratio during the early 1990s. It therefore appears that the early 1990s break is not common across all parts of the market and so it seems unlikely that this change is due to a systematic factor impacting all areas of the market at the same time. If there was a common decline in a common risk factor during the 1990s that lead to a decline in equity premium then all portfolios should be affected.

Furthermore some additional comment should be made regarding the use of dividend growth model in light of the analysis contained in Chapters 4 and 5. In Chapters 4 and 5 we find the dividend growth model for 1966-2002 implies equity premia are substantially below the historical average equity premia. However, the earnings growth model implies equity premia which are approximately the same as the historical average equity premia once the 1974 spike is neutralised across most portfolios be they based on industry or size characteristics. This suggests there's a possibility our results from Chapter 3 for the dividend growth model are reflecting the flaws of the dividend growth model. Since, the dividend model is subject to the changes in corporate payout policy which have occurred over recent decades in the UK even though these changes haven't been as dramatic as in the US. Therefore it can be asserted that earnings growth is perhaps a better measure of fundamental growth over the more recent period. Hence if we had earnings data available for the whole of the 1951-2002 period then it is plausible that the earnings model might imply equity premia in-line with the historical average.

Nevertheless, there is a caveat in relation to our analysis in Chapters 4 and 5. This is that due to data availability the analysis begins in 1966. The question which has to be asked is how representative was this period of earlier years. Particularly, were ratios of fundamental-price in the years surrounding 1966 at levels approximately representative of the earlier 20$^{th}$ Century? We can assert that equity premia have been approximately equal to historical returns over 1966-2002 when earnings growth is used as the measure of fundamentals, but this doesn't rule out the possibility that there could have been a divergence between estimates for earlier periods. Perhaps of more importance our finding that historical equity premia have been approximately in-line with earnings growth could be partly attributed to unusual levels of valuation ratio in the 1960s.

**FIGURE 6.1 UK DIVIDEND-PRICE AND EARNINGS-PRICE RATIOS**




In fact, when we look at the aggregate dividend-price ratio for 1901-2002, depicted in Figure 6.1, we discover that the late 1960s and early 1990s were both periods that were somewhat different from the pre-1966 period. In fact from 1967-1973, the dividend-price ratio was substantially below its prior mean; both dividend-price and earnings-price ratios are low over 1967-73 relative to the latter 1970s and the 1980s, Figure 6.1 reveals. This, therefore contributes to the findings we make in Chapters 4 and 5 from our earnings growth models that expected returns didn't appear to decline over 1966-2002. This is because 1967-1973 appears to be a regime of low valuation-price ratios and hence of low expected returns relative to the earlier pre-1965 period. Hence the fact that our cross-sectional analyses appear to begin during a period when valuation ratio were at then historically low levels will contribute to the findings reported in Chapters 4 and 5.

Despite the efforts of this thesis, there almost inevitably remain some unresolved issues in relation to the equity premium. We therefore proceed to make some suggestions and outline a number of areas where further research is likely to prove both fruitful for both informing and developing our knowledge of the equity premium even further.

Firstly, there is still relatively little known about the expected equity premia for countries outside the US and the UK. Hence analysis of countries with a different legal and institutional framework to the systems employed in these countries would in my opinion provide a fruitful area of new research. This would enable the identification of how far the results reported in this thesis could be generalised and transferred to other countries or whether they are merely a product of the legal system, institutional framework and historical heritage of the United Kingdom. In particular for such an analysis it would be important to consider both the equity premia across portfolios formed on characteristics as well as the aggregate market. This is particularly so given that this thesis identifies results for the aggregate level do not automatically transfer to portfolios formed on the basis of cross-sectional characteristics. This, therefore, would appear to be a useful and fruitful area for future analysis, which could build on and further expand the results and conclusions drawn from this thesis.

Another issue is also in relation to the study of the equity premium in cross-sectionally sorted portfolios. Although, our studies in Chapters 4 and 5 use as long a

UK dataset as can be provided by Datastream, it would be desirable to extend the sample period of study even further. This would be of interest and benefit given the focus upon the use of long-term averages in our equity premia estimates. Hence if, in an ideal world the sample period could be extended to a period of 50, 60 or even 100 years, this might perhaps allow for greater accuracy in the estimation of equity premia. While for many countries this is likely to prove infeasible, it could be possible to conduct such a study in the US given both market and accounting data is available for a broad cross-section of firms from at least the 1940's. Hence, despite the almost fervent focus and fixation of the prior literature upon the equity premium in the US, there do still remain unexplored avenues of research even for this market. Moreover, a few years farther into the future such a study would also be feasible for a growing number of countries around the world, especially amongst those with more developed capital markets.

Another possibility for future research would be to examine the predictability and forecastability of the aggregate historical equity premium. Most of the extant literature focuses upon the post-1975 period and analyses monthly or quarterly forecasts. There is therefore a gap in the literature for a study that examines the forecastability of equity returns for the pre-1975 period. Such a study could also contribute to our knowledge of equity returns by examining lower frequency forecastability rather than the high-frequency focus of the recent literature. This could therefore prove to be another fertile field for research which could be cultivated.

The equity premium is a cornerstone of modern financial practice and utilised in numerous applications, as discussed in the Introduction of this thesis. The analysis conducted in this thesis therefore provides an important new resource for policy makers in diverse areas such as investment analysis, financial managers as well as pension funds. We provide a thorough and comprehensive analysis of the UK equity premium. Our focus is on the past performance of the equity premium, our study nevertheless is of considerable value to practitioners. For instance, practitioners often use historical equity premia as the main foundation for predicting future equity premia. Hence our results have important implications for such agents.

Firstly, our findings point to the importance of removing outliers when calculating historical average returns. We find in Chapters 4 and 5 that the failure to neutralise the impact of such outliers can cause a discrepancy between equity premia estimates. Secondly, once outlying observations are neutralised, since 1966 cross-sectional historical equity premia are consistent with those implied by earnings growth. Thirdly, it seems important to use a reasonably long period in order to estimate the equity premia as this will aid the precision of the estimates. Our results underline that the use of just data from the late 1970s or even shorter samples could lead to discrepancies between equity premia estimates from the different models. Therefore together these results provide evidence suggesting that since 1966 and once outliers are neutralised that the historical average equity premia appears to be in-line with those that could have been reasonable expected by investors. This therefore serves to suggest that practitioners can place greater confidence and receive re-assurance from these findings.

# BIBLIOGRAPHY

Abarbanell J and Bernard V (1992), Tests of Analysts' Overreaction / Underreaction to Earnings Information as an Explanation for Anomalous Stock Price Behaviour, Journal of Finance 47: 1181-1207

Abarbanell J (1991), Do Analysts' Earnings Forecasts Incorporate Information in Prior Stock Price Changes?, Journal of Accounting and Economics 14: 147-65

Abel A (1990), Asset Prices Under Habit Formation and Catching Up With the Joneses, American Economic Review, 80: 38-42

Ackert L and Smith B (1993), Stock Price Volatility, Ordinary Dividends and Other Cash Flows to Shareholders, Journal of Finance, 48: 1147-1160

Aiygari S and Gertler M (1991), Asset Returns with Transaction Costs and Uninsured Individual Risk, Journal of Monetary Economics, 27: 311-331

Ang A (2002), Characterizing the Ability of Dividend Yields to Predict Future Dividends in Log-Linear Present Value Models, Unpublished working paper, Columbia Business School

Antoniou A, Garrett I and Priestley R (1998), Calculating the Equity Cost of Capital Using the APT: The Impact of the ERM, Journal of International Money and Finance 17: 949-965

Antoniou A, Garrett I and Priestley R (1998), Macroeconomic Variables as Common Pervasive Risk Factors and the Empirical Content of the Arbitrage Pricing Theory, Journal of Empirical Finance, 5: 221-240

Ap Gwilym O, Seaton J and Thomas S (2004), Dividends, Earnings, the Payout Ratio and Returns: A Century of Evidence from the US and UK, University of Southampton Discussion Paper AF04-14

Ap Gwilym O, Seaton J, Suddason K and Thomas S (2006), International Evidence on Payout Ratio, Returns, Earnings and Dividends, Financial Analysts Journal, 62 (1): 36-53

Arbel A and Strebel P (1982), The Neglected and Small Firm Effects, Financial Review, 17: 201-218

Arbel A and Strebel P (1983), Pay Attention to Neglected Firms!, Journal of Portfolio Management, 9 (Winter): 37-42

Arnott R and Asness C (2003), Surprise! Higher Dividends = Higher Earnings, Financial Analysts Journal 59 (1): 70-87

Arnott R and Bernstein P (2002), What Risk Premium is 'Normal'?, Financial Analysts Journal 58 (2): 64-85

Arrow K (1971), Essays in the Theory of Risk-bearing, North Holland, Amsterdam

Bai J and Perron P (1998), Estimating and Testing Linear Models with Multiple Structural Changes, Econometrica 66: 47-78

Bai J and Perron P (2003), Computation and Analysis of Multiple Structural Change Models, Journal of Applied Econometrics 18: 1-22

Ball R (1978), Anomalies in Relationships between Securities' Yields and Yield Surrogates, Journal of Financial Economics, 6: 103-126

Banerjee A, Lumsdaine R and Stock J (1992), Recursive and Sequential Tests of the Unit-Root and Trend-Break Hypotheses: Theory and International Evidence, Journal of Business and Economic Statistics 10: 271-287

Bansal R and Lundblad C (2002), Market Efficiency, Asset Returns, and the Size of the Risk Premium in Global Equity Markets, Journal of Econometrics 109: 195-237

Banz R (1981), The Relationship between Return and Market Value of Common Stocks, Journal of Financial Economics, 9: 3-18

Barberis N, Huang M and Santos T (2001), Prospect Theory and Asset Prices, Quarterly Journal of Economics 116: 1-53

Basu S (1977), Investment Performance of Common Stocks in relation to their Price-earnings ratio: A test of the Efficient Market Hypothesis, Journal of Finance, 32: 663-682

Beenstock M and Chan K (1988), Economic Forces in the London Stock Market, Oxford Bulletin of Economics and Statistics, 50: 27-39

Benartzi S and Thaler R (1995), Myopic Loss Aversion and the Equity Premium Puzzle, Quarterly Journal of Economics, 110: 73-92

Berenson A (2003), The Number, Simon & Schuster, London, UK

Berges A, McConnell J and Schlarbaum G (1984), The Turn of the Year in Canada, Journal of Finance, 39: 185-192

Berk J (1995), A Critique of Size-related Anomalies, Review of Financial Studies, 8: 275-286

Black F (1990), Mean Reversion and Consumption Smoothing, Review of Financial Studies 3: 107-114

Black F (1993a), Estimating Expected Return, Financial Analysts Journal (Sept./Oct.) 36-38

Black F (1993b), Beta and Return, Journal of Portfolio Management, 20: 8-18

Bodie Z, Kane A and Marcus A (1996), Investments 4th ed., McGraw-Hill, Singapore

Bogle J (1999), Common Sense on Mutual Funds, New York, John Wiley and Sons

Bond T, Capleton M, Cleary F and Kochugovindan S (2003), Barclays Equity Gilt Study 2003 (48th Edition), London

Brav A, Constantinides G and Geczy C (2002), Asset Pricing with Heterogeneous Consumers and Limited Participation: Empirical Evidence, Journal of Political Economy 110: 793-824

Brown P, Keim D, Kleidon A and Marsh T (1983), Stock Return Seasonalities and the Tax-loss Selling Hypothesis: Analysis of the Arguments and the Australian evidence, Journal of Financial Economics, 12: 105-128

Brown S, Goetzmann W and Ross S (1995), Survival, Journal of Finance 50: 853-873

Campbell J and Shiller R (1988), Stock Prices, Earnings and Expected Dividends, Journal of Finance 43: 661-676

Campbell J and Shiller R (1998), Valuation Ratios and The Long-Run Stock Market Outlook, Journal of Portfolio Management 24 (2): 11-26

Campbell J (1991), A Variance Decomposition for Stock Returns, Economic Journal, Vol.101 (2) (March), pp.157-79.

Campbell J (1996), Consumption, and the Stock Market: Interpreting International Evidence, Swedish Economic Policy Review 3: 251-299

Campbell J (1999), Asset Prices, Consumption and the Business Cycle in: Handbook of Macroeconomics Eds: Taylor J and Woodford M (1999), Elsevier Science, Amsterdam

Campbell J (2000), Asset Pricing at the Millenium, Journal of Finance, 55: 1515-1568

Campbell J (2003), Consumption Based Asset Pricing in: Handbook of the Economics of Finance Ed: Constantinides G et al (2003), Elsevier Science, Amsterdam

Carlson J, Pelz E and Wohar M (2002), Will Valuation Ratios Revert to Their Historical Means? Some Evidence From Breakpoint Tests, Journal of Portfolio Management (Summer) 23-35

Cecchetti S, Lam P and Nelson M (1993), The Equity Premium and the Risk-free Rate: Matching the Moments, Journal of Monetary Economics, 31:21-45

Chan K and Chen N (1988), An Unconditional Asset-pricing Test and the Role of Firm Size as an Instrumental Variable for Risk, Journal of Finance, Journal of Finance, 43: 309-325

Chan K, Chen N and Hsieh D (1985), An Exploratory Investigation of the Firm Size Effect, Journal of Financial Economics, 14: 451-471

Chang M (1990), A Resolution to the Equity Premium Puzzle, Economic Letters, 32: 153-156

Chapman D (2002), Does Intrinsic Habit Formation Actually Resolve the Equity Premium Puzzle?, Review of Economic Dynamics 5: 618-645

Chen N (1983), Some Empirical Tests of Arbitrage Pricing, Journal of Finance, 38: 1393-1414

Chen N (1988), Equilibrium Asset Pricing Models and the Firms Size Effect, in: Dimson E (ed.), Stock Market Anomalies, Cambridge University Press, Cambridge

Chen N , Roll R and Ross S (1986), Economic Forces and the Stock Market, Journal of Business, 59: 383-403

Clare A and Thomas S (1994), Macroeconomic Factors, the APT and the UK stockmarket, Journal of Business Finance and Accounting, 21(3): 309-330

Claus J and Thomas J (2001), Equity Premia as low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Markets, Journal of Finance 56: 1629-1666

Cochrane J (1994), Permanent and Transitory Components of GNP and Stock Prices, Quarterly Journal of Economics (February 1994) : 241-265

Cochrane J (2007), Financial Markets and the Real Economy in: Handbook of the Equity Risk Premium Ed: Mehra R (2007), Elsevier Science, Amsterdam

Coghlan H (1988), Small firms versus large on the Irish stock exchange: An analysis of the performances 1977-1986, Irish Business Administration Research, 9: 10-20

Connor G and Korajczyk R (1993), A Test for the Number of Factors in an Approximate Factor Model, Journal of Finance, 48: 1263-1291

Constantinades G (1990), Habit Formation: A Resolution of the Equity Premium Puzzle, Journal of Political Economy, 98: 519-543

Constantinides G and Duffie D (1996), Asset Pricing with Heterogeneous Consumers, Journal of Political Economy 104: 219-240

Constantinides G, Donaldson J and Mehra R (2002), Junior Can't Borrow: A New Perspective on the Equity Premium Puzzle, Quarterly Journal of Economics 117: 269-96

Corhay A, Hawawini G and Michel P (1987), The Pricing of Equity on the London Stock Exchange: Seasonality and Size premium, in : Dimson E (ed.), Stock Market Anomalies, Cambridge University Press, Cambridge

Corniolay C and Pasquier J (1991), CAPM, Risk Premium Seasonality and the Size Anomaly: The Swiss case, Finance (Journal of French Finance Association), 12(1): 23-44

DeAngelo H, DeAngelo L and Skinner D (2004), Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings, Journal of Financial Economics 72: 425-456

Dickey D and Fuller W (1979), Distribution of the Estimators for Autoregressive Time Series With a Unit Root, Journal of the American Statistical Association, 74: 427-431

Diebold F and Mariano R (1995), Comparing Predictive Accuracy, Journal of Business and Economic Statistics, 13: 253-263

Dimson E and Marsh P (1999), Murphy's Law and Market Anomalies, Journal of Portfolio Management, 25(2), 53-69

Dimson E and Marsh P (2000), The Demise of Size, in: Keim D and Ziemba W (eds.) Security Market Imperfections in Worldwide Equity Markets, Cambridge University Press, Cambridge

Dimson E and Marsh P (2001), U.K. Financial Market Returns 1955-2000, Journal of Business 74: 1-31

Dimson E (1979), Risk Measurement when Shares are subject to Infrequent Trading, Journal of Financial Economics, 7: 197-226

Dimson E (1988), Stock Market Anomalies, Cambridge University Press, Cambridge

Dimson E, Marsh P and Staunton M (2002), Triumph of The Optimists, Princeton University Press, Princeton, New Jersey

Dimson E, Marsh P and Staunton M (2003), Global Evidence on the Equity Risk Premium, Journal of Applied Corporate Finance 15 (4): 27-38

Dimson E, Nagel S and Quigley G (2003), Capturing the Value Premium in the UK, Financial Analysts Journal 59 (6): 35-45

Donaldson G, Kamstra M and Kramer L (2003), Stare Down the Barrel and Center the Crosshairs: Targeting the Ex Ante Equity Premium, Federal Reserve Bank of Atlanta WP 2003-4

Driscoll J and Kraay A (1998), Consistent Covariance Matrix Estimation With Spatially Dependent Panel Data, Review of Economics and Statistics, Vol. 80 No.4: 549-560

Duesenberry J (1967), Income, Saving and the Theory of Consumer Behaviour, OUP, New York

Epstein L and Zin S (1989), Substitution, Risk Aversion and the Temporal Behaviour of Consumption Growth and Asset Returns I: A Theoretical Framework, Econometrica, 57:937-969

Epstein L and Zin S (1991), Substitution, Risk Aversion and the Temporal Behaviour of Consumption Growth and Asset Returns II: An Empirical Analysis, Journal of Political Economy, 99: 263-286

Fama E (1970), Efficient capital markets: A Review of Theory and Empirical work, Journal of Finance, 25: 383-417

Fama E (1991), Efficient capital markets: II, Journal of Finance, 46, 1575-1617

Fama E and French K (1988), Dividend Yields and Expected Stock Returns, Journal of Financial Economics 22: 3-27

Fama E and French K (1992), The cross-section of expected returns, Journal of Finance, 47: 427-466

Fama E and French K (1993), Common risk factors in the returns on stocks and bonds, Journal of Financial Economics, 33: 3-56

Fama E and French K (1996), Multi-factor Explanations of Asset Pricing Anomalies, Journal of Finance, 51: 55-87

Fama E and French K (2001), Disappearing Dividends: Changing Firm Characteristics or Lower Propensity to Pay?, Journal of Finance Economics 60: 3-44

Fama E and French K (2002), The Equity Premium, Journal of Finance 57: 637-659

Fielding D and Stracca L (2003), Myopic Loss Aversion, Disappointment Aversion and The Equity Premium Puzzle, ECB Working Paper 203

Fletcher J and Kihanda J (2005), An Examination of Alternative CAPM-based models in UK stock returns, Journal of Banking and Finance 29: 2995-3014

Friend I and Blume M (1975), The Demand for Risky Assets, American Economic Review, 65: 900-922

Gebhardt W, Lee C and Swaminathan B (2001), Toward an Implied Cost of Capital, Journal of Accounting Research 39: 135-176

Gibbons M (1982), Multivariate Tests of Financial Models: A New Approach, Journal of Financial Economics, 10: 3-27

Gibbons M, Ross S and Shanken J, (1989), A Test of the Efficiency of a given Portfolio, Econometrica, 57: 1121-1152

Gillan F (1990), An Investigation into CAPM Anomalies in New Zealand: the Small Firm and Price Earnings ratio Effects, Asia Pacific Journal of Management, 7: 63-78

Gordon M., (1962), 'The Investment, Financing and Valuation of the Corporation', Homewood, Ill., Richard D Irwin.

Grullon G and Michaely R (2002), Dividends, Share Repurchases and the Substitution Hypothesis, Journal of Finance 57: 1649-1684

Gul F (1991), A Theory of Disappointment Aversion, Econometrica 59: 667-686

Guvenen F (2005), A Parsimonious Macroeconomic Model for Asset Pricing: Habit Formation or Cross-Sectional Heterogeneity?, Unpublished Working Paper (University of Rochester)

Hall R (1988), Intertemporal Substitution in Consumption, Journal of Political Economy, 96:339-357

Handa P, Kothari S and Wasley C (1989), The relation between the return interval and beta: Implications for the size effect, Journal of Financial Economics, 23: 79-100

Hansen L and Jagannathan R (1991), Implications of Security Market Data for Models of Dynamic Economies, Journal of Political Economy 99: 225-262

Harvey D, Leybourne S and Newbold P (1997), Testing the Equality of Prediction Mean Squared Errors, International Journal of Forecasting, 13: 281-291

Haugen R (1995), The New Finance: The Case against Efficient Markets, Prentice Hall, New York

Hawawini G and Keim D (1995), On the Predictability of Common Stock Returns: World-wide evidence in: Jarrow R, Maksimovic V and Ziemba W (eds.), Handbooks in Operational Research and Management Science Volume 9: Finance, Elsevier Science, Amsterdam

Hawawini G and Keim D (2000), The Cross-section of Common Stock Returns: A Synthesis of the Evidence and the Explanations, in: Keim D and Ziemba W (eds.) Security Market Imperfections in Worldwide Equity Markets, Cambridge University Press, Cambridge

Hawawini G and Viallet C (1987), Seasonality, Size Premium and the Relationship between the Risk and Return of French Common Stocks, Working Paper, INSEAD and the Wharton School of the University of Pennsylvania

Hawawini G, Michel P and Corhay A (1989), A Look at the Validity of the Capital Asset Pricing Model: The case of Belgian Common Stocks, in: Taylor S (ed.), A Reappraisal of the Efficiency of Financial Markets, NATO ASI Series, Springer-Verlag

He H and Modest D (1995), Market Frictions and Consumption-Based Asset Pricing, Journal of Political Economy 103: 94-117

He J and Ng L (1994), Economic Variables and Equity returns, Journal of Business, 67: 599-609

Healy P and Wahlen J (1999), A Review of the Earnings Management Literature and its Implications for Standard Setting, Accounting Horizons, 13: 365-383

Heaton J and Lucas D (1996), Evaluating the Effects of Incomplete Markets on Risk Sharing and Asset Pricing, Journal of Political Economy 104: 668-712

Heaton J (1995), An Empirical Investigation of Asset Pricing with Temporally Dependent Preference Specifications, Econometrica, 63: 681-717

Hong H, Torous W and Valkanov R (2006), Do Industries Lead Stock Markets?, Journal of Financial Economics, 83: 367-396

Horowitz J, Loughran T and Savin N (2000), The Disappearing Size Effect, Research in Economics, 54: 83-100

Jaffe J, Keim D and Westerfield R (1989), Earnings yields, market values and stock returns, Journal of Finance, 45: 135-148

Jagannathan R, McGrattan E and Scherbina A (2001), The Declining US Equity Premium, NBER WP 8172

Jegadeesh N (1992) 'Does Market Risk Really Explain the Size Effect,' Journal of Financial and Quantitative Analysis', 27: 337-352

Jones C (2000), A Century of Stock Market Liquidity and Trading Costs, Working paper, Columbia University

Jorion P and Goetzmann W (1999), Global Stock Markets in the 20th Century, Journal of Finance, 54: 953-980

Kahneman D and Tversky A (1979), Prospect Theory: An Analysis of Decision Under Risk, Econometrica 47: 263-291

Kandel S and Stambaugh R (1991), Asset Returns and Intertemporal Preferences, Journal of Monetary Economics, 27: 39-71

Keane M and Runkle D (1998), Are Financial Analysts' Forecasts of Corporate Profits Rational?, Journal of Political Economy 106: 768-805

Keim D and Ziemba W eds. (2000), Security Market Imperfections in Worldwide Security Markets, Cambridge University Press, Cambridge

Keim D (1983), Size Related Anomalies and Stock Return Seasonality: Further Empirical Evidence, Journal of Financial Economics, 12: 13-32

Keim D (1990), A New Look at the Effects of Firm Size and E/P ratio on Stock Returns, Financial Analysts Journal, 46(2): 56-67

Keim D (1999), An Analysis of Mutual Fund Design: The Case of Investing in Small-cap Stocks, Journal of Financial Economics, 51: 173-194

Knez P and Ready M (1996), Estimating the Profits from Trading Strategies, Review of Financial Studies, 9: 1121-1163

Knez P and Ready M (1997), On the Robustness of Size and Book-to-market in Cross-sectional Regressions, Journal of Finance, 52: 1355-1382

Kocherlakota N (1996), The Equity Premium: It's Still a Puzzle, Journal of Economic Literature, 34: 42-71

Kothari S, Shanken J and Sloan R (1995), Another Look at the Cross-section of Expected Returns, Journal of Finance, 50: 185-224

Lehmann B and Modest D (1988), The Empirical Foundations of the Arbitrage Pricing Theory, Journal of Financial Economics, 21: 213-254

Lettau M and Uhlig H (2000), Can Habit Formation be Reconciled with Business Cycle Facts, Review of Economic Dynamics 3: 79-99

Lettau M and Uhlig H (2002), The Sharpe Ratio and Preferences: A Parametric Approach, Macroeconomic Dynamics 6: 242-265

Lettau M, Ludvigson S and Wachter J (2006), The Declining Equity Premium: What Role Does Macroeconomic Risk Play?, Review of Financial Studies, forthcoming

Levis M (1985), Are Small Firms Big Performers?, Investment Analyst, 76: 21-27

Lintner J (1956), Distribution of Incomes of Corporations Among Dividends, Retained Earnings and Taxes, American Economic Review, 68: 97-113

Lintner J (1965), The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, Review of Economics and Statistics, 47: 13-37

Liu J, Wu S, Zidek JV (1997), On Segmented Multivariate Regressions, Statistica Sinica 7: 497–525.

Lo A and MacKinlay C (1990), Data Snooping Biases in tests of Financial Asset Pricing Models, Review of Financial Studies, 3: 431-468

Longstaff F and Piazzesi M (2004), Corporate Earnings and the Equity Premium, Journal of Financial Economics, 74: 401-421

Lucas D (1994), Asset Pricing with Undiversifiable Risk and Short Sales Constraints: Deepening the Equity Premium Puzzle, Journal of Monetary Economics, 34: 325-342

Lucas R (1978), Asset Pricing in an Exchange Economy, Econometrica, 46: 1429-1445

Luttmer E (1996), Asset Pricing in Economies with Frictions, Econometrica 64: 1439-1467

Ma T and Shaw T (1990), The Relationships between Market Value, P/E ratio, Trading Volume and the Stock Return of Taiwan Stock Exchange, in: Rhee S and Chang R (eds.), Pacific-Basin Capital Markets Research Volume 1, North Holland, Amsterdam

MacKinlay C (1995), Multifactor Models do not Explain Deviations from the CAPM, Journal of Financial Economics, 38: 3-28

Maki A and Sonoda T (2002), A Solution to the Equity Premium and Risk-free Rate Puzzles: An Empirical Investigation using Japanese Data, Applied Financial Economics 12: 601-612

Mankiw N and Zeldes S (1991), The Consumption of Stockholders and Non-stockholders, Journal of Financial Economics, 29: 97-112

Megginson W (1997), Corporate Finance Theory, Reading Mass., Addison Wesley

Mehra R and Prescott E (1985), The Equity Premium: A Puzzle, Journal of Monetary Economics, 15: 145-161

Mehra R and Prescott E (1988), The Equity Risk Premium: A Solution?, Journal of Monetary Economics, 22: 133-136

Mehra R and Prescott E (2003), The Equity Premium Puzzle: In Retrospect, in: Handbook of the Economics of Finance Ed: Constantinides G et al (2003), Elsevier Science, Amsterdam

Melino A and Yang A (2003), State-Dependent Preferences Can Explain the Equity Premium Puzzle, Review of Economic Dynamics 6: 806-830

Menzly, L., T. Santos and P. Veronesi (2004), 'Understanding Predictability', Journal of Political Economy, Vol. 112, No.1 (February), pp. 1-47.

Morgan G and Thomas S (1998), Taxes, Dividend Yields and Returns in the UK Equity Market, Journal of Banking and Finance, 22: 405-423

Oswald D and Young S (2004), What Role Taxes and Regulation? A Second Look at Open Market Share Buyback Activity in the U.K., Journal of Business Finance and Accounting, Vol. 31, No. 1-2, pp. 257-292.

Parker J (2001), The Consumption Risk of the Stock Market, Brookings Papers on Economic Activity, Vol 2: 279-348

Pastor L and Veronesi P (2003), Stock Valuation and Learning about Profitability, Journal of Finance 58: 1749-1789

Perron P (1997), L'estimation de modeles avec changements structurels multiples, Actualite Economique 73: 457–505.

Priestley R (1996), The Arbitrage Pricing Theory, Macroeconomic and Financial factors, and Expectations Generating Processes, Journal of Banking and Finance, 20: 869-890

Priestley R (1997), Seasonality, Stock Returns and the Macroeconomy, The Economic Journal, 107: 1742-1750

Rabin M and Thaler R (2001), Anomalies: Risk Aversion, Journal of Economic Perspectives, 15: 219-232

Rabin M, Risk Aversion and Expected-Utility Theory: A Calibration Theorem, Econometrica 68: 1281-1292,

Rau P and Vermaelen T (2002), Regulation, Taxes, and Share Repurchases in the United Kingdom, Journal of Business, 75: 245-282

Reinganum M (1981), A Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings Yields and Market Values, Journal of Financial Economics, 9: 19-46

Reinganum M (1982), A Direct Test of Roll's Conjecture on the Firm Size Effect, Journal of Finance, 37: 27-35

Rietz T (1988), The Equity Risk Premium: A Solution?, Journal of Monetary Economics, 22: 117-131

Roll R (1981), A Possible Explanation of the Small Firm Effect, Journal of Finance, 36: 879-888

Roll R (1994), What every CEO should know about Scientific Progress in Economics: What is known and what remains to be resolved, Financial Management, 23 (Summer): 69-75

Ross S (1976), The Arbitage Theory of Capital Asset Pricing, Journal of Economic Theory, 13: 341-360

Rozeff M and Kinney W (1976), Capital Market Seasonality: The Case of Stock Returns, Journal of Financial Economics, 3: 379-402

Rubio G (1986), Size, Liquidity and Valuation, working paper, Southern European Discussion Series, Universidad del Pais Vasco

Scholes M and Williams J (1977), Estimating Betas from Non-synchronous Data, Journal of Financial Economics, 5: 309-328

Sentana E (2002), Did The EMS Reduce The Cost of Capital?, Economic Journal 112: 786-809

Shanken J and Weinstein M (1990), Macroeconomic Variables and Asset Pricing: Estimation and Tests, Working Paper, University of Rochester

Shanken J (1992), On the Estimation of Beta-pricing models, Review of Financial Studies, 5: 1-33

Sharpe W (1964), Capital Asset Prices: A Theory of Market Equilibrium under conditions of Risk, Journal of Finance, 19, 425-442

Shrikhande M (1997), Non-addictive Habit Formation and the Equity Premium Puzzle, European Financial Management 3: 293-319

Shukla R and Trzcinka C (1990), Sequential tests of the Arbitrage Pricing Theory, Journal of Finance, 45: 1541-1564

Shumway T (1996), Size Over-reaction and Book-to-market Effects as Default Premia, working paper, University of Michigan

Siegel J and Thaler R (1997), Anomalies: The Equity Premium Puzzle, Journal of Economic Perspectives 11: 191-200

Siegel J (1992), The Equity Premium: Stock and Bond Prices since 1802, Financial Analysts Journal Jan/Feb, 28-38

Siegel J (1999), The Shrinking Equity Premium: Historical Facts and Future Forecasts, Journal of Portfolio Management 26 (1): 11-16

Stehle R (1992), The Size Effect in the German Stock Market, unpublished manuscript, University of Augsburg

Stoll H and Whaley R (1983), Transaction Costs and the Small Firm Effect, Journal of Financial Economics, 12: 57-80

Stulz R (1999), Globalization, Corporate Finance and The Cost of Capital, Journal of Applied Corporate Finance 12: 8-25

Sunadaresan S (1989), Intertemporally Dependent Preferences and the Volatility of Consumption and Wealth, The Review of Financial Studies 2: 73-89

Tversky A and Kahneman D (1991), Loss Aversion and Riskless Choice: A Dependent Model, Quarterly Journal of Economics 57: 1039-1061

Vivian A (2005), The Equity Premium: 101 Years of Empirical Evidence from the UK., University of Durham Working Paper 2005/01

Wahlroos B and Bergland T (1986), Risk, Return and Equilibrium Returns in a Small Stock Market, Journal of Business Research, 14: 423-440

Weil P (1989), The Equity Premium Puzzle and the Risk-free Rate Puzzle, Journal of Monetary Economics, 24: 401-421

Welch I (2000), Views of Financial Economists On the Equity Premium And Other Issues, Journal of Business 73: 501-53

Yogo M (2004), Estimating the Elasticity of Intertemporal Substitution When Instruments Are Weak, Review of Economics and Statistics, 86: 797-810

Young, S.E. and D. Oswald (2004), Open Market Share Reacquisitions, Surplus Cash, and Agency Problems, Working Paper (University of Lancaster).

Ziemba W (1991), Japanese security market regularities. Monthly, Turn-of-the-month and year, Holiday and Golden week effects, Japan World Economics, 3(2): 119-146